

BROWN AND
CALDWELL

Environmental Engineers & Consultants

July 18, 2008

Mr. Donald Webster
USEPA Region IV
Atlanta Federal Center
61 Forsyth Street, SW
Atlanta, GA 30303-8960

**Subject: Revised Corrective Measures Pre-design Investigation Results Report Revision
and Responses to Comments**

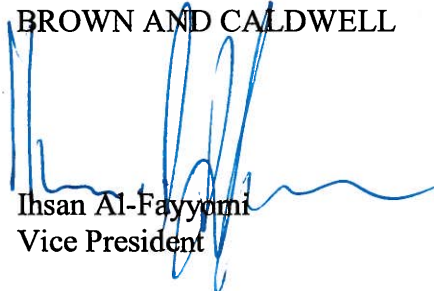
Dear Mr. Webster.

On behalf of ArvinMeritor Inc., Brown and Caldwell is submitting the enclosed Responses to EPA Comments on the Draft Corrective Measures Pre-design Investigation Results Report, and three hardcopies of the revised report that incorporates the changes discussed in the attached responses.

Please review our responses and the revised report at your earliest convenience. Should you have any questions or further comments concerning the information presented in the report, please do not hesitate to contact me at 614-410-3144 or Debra Chelf of ArvinMeritor.

Very truly yours,

BROWN AND CALDWELL



Ihsan Al-Fayyomi
Vice President

cc: Debra Chelf, ArvinMeritor, Inc.
Linda Furlough, ArvinMeritor, Inc.
Jeffrey Karp, Sullivan & Worcester LLP
file

enclosures (2)

ArvinMeritor, Inc.'s Responses to EPA Comments Draft Corrective Measures Pre-design Investigation Results Report

ArvinMeritor, Inc. has reviewed and accepted all of EPA's comments on the draft Corrective Measures Pre-design Investigation Results Report that was submitted to the Agency on February 21, 2008. In order to assist the EPA in reviewing our responses and revisions to the report, we have provided the Agency's comments below in italics followed by our responses. Where changes to the report were necessary in response to a comment, we provide the changes made, and reference the report section number, page, and paragraph number where the changes can be found. Mr. Donald Webster's comments are addressed first, followed by the comments provided by Ms. Sharon Matthews and SESD.

Mr. Donald Webster's Comments:

Comment 1. The purpose of the Corrective Measures Pre-design Investigation Results was consistent with the Corrective Measures Pre-design Workplan. EPA considers that the former report satisfies the requirements for a Corrective Measures Study Report, while the latter report satisfies the requirements for a Corrective Measures Study Workplan. With the approval or conditional approval of the Corrective Measures Study Report, Grenada Manufacturing will be able to move forward with construction of the selected and approved remedy.

Response: Accepted. The *Corrective Measures Pre-design Investigation Results* report has been revised to address EPA comments as described in the responses below.

Comment 2. Section 1.4 of the CMS report correctly identifies the remaining remedial situations at the facility.

Response: Agreed. No changes were made to this section of the report.

Comment 3. EPA agrees with the facility's assessment that the Lagoon Temporary Wells and the Plant Temporary Wells may now be abandoned according to Mississippi State requirements.

Response: Plans are in place to mobilize to the Site to abandon the temporary wells accordingly. We propose that the mobilization coincide with the planned indoor air sampling events in August 2008 (see Response to Comment 5). No changes were made to this section of the report.

Comment 4. EPA agrees with the facility's decision to close the Sludge Lagoon Area with in-place stabilization of the sludge based on the data and recommendations made in Section 4.0 of the CMS Report and to construct a cap system based on the vadose zone delineation results described in section 3.0 of the Report. If this is not a clean closure, i.e., the lagoon is being closed with waste in place, then the facility must add the Sludge Lagoon, SWMU 4 to the Financial Assurance Plan for the facility in accordance with the permit.

Response: Subsequent to EPA's comments, Mr. Donald Webster correctly pointed out that the Sludge Lagoon activities are included in the existing Financial Assurance Plan. The relevant

portion of that Plan has been added to the revised Corrective Measures Pre-design Investigation Results Report as Appendix D: Financial Responsibility Requirements for Closure and Post Closure Care of Treatment Storage and Disposal Facilities. The following text was added as the third bullet in Section 3-4 on page 3-4 to direct the reader to Appendix E as needed.

- “3. The closure and post-closure costs are included in the current Financial Assurance Plan (see Appendix D). Because the Sludge Lagoon will be closed with the sludge left in place, the post closure costs will be updated based on the needs for post closure maintenance and monitoring, and those costs will be included in the Financial Assurance Plan accordingly.”

Comment 5. AOCs A and B, are the main sources of TCE and toluene contamination whereas the location of the former Chrome Plating Lines downgradient of AOCs A and B is one of the main sources of Hexavalent Chromium contamination at the plant. Flux of LNAPL and DNAPL contaminants toward the already installed Permeable Reactive Barrier may be desirable. At the same time EPA wishes to confine the Hexavalent Chromium Plume under the Main Plant Building where it has an Institutional Control until plant closure. However, the most important factor here is the potential for indoor air contamination of the Main Plant Building from the toluene and TCE contamination. Therefore, anything which retards the flushing or breakdown of TCE and toluene contamination is less desirable. The EPA accepts the facility's recommendations in Section 6.4 of the CMS Report, including the commitment to conduct an additional indoor air monitoring event. The last indoor air monitoring events were conducted in February and August of 2004. EPA is of the opinion that both 'heating' and 'cooling' temporal events are necessary for a complete evaluation. Therefore, EPA would like the paired event repeated in 2009 using the same monitoring locations as before. If the results of the 2009 monitoring confirm that TCE and Toluene are flushing from under the Main Plant Building, and there is no buildup of Indoor Air contaminants, then future Indoor Air Monitoring can be suspended and the Sheet Pile Barrier need not be built.

Response: We agree with EPA's opinion that paired sampling events be performed during heating and cooling periods to complete the evaluation. We propose to perform the sampling events in August 2008 and February 2009. If the results from the paired samples confirm that there is not a buildup of contaminants in indoor air, future air monitoring will be suspended. The following text was added to Section 5.4, page 5-6, 2nd paragraph.

“To complete the evaluation of potential LNAPL (i.e., toluene and TCE) impacts to indoor air quality, it is recommended that the same locations from the previous monitoring events be sampled. The sampling would be conducted in a pair of temporal monitoring events to be performed during the “heating” and “cooling” periods. It is further recommended that the first monitoring event take place in August 2008 and the second event occur in February 2009. If the results from these paired events confirm that toluene and TCE are flushing from under the Main Plant Building, and there is no buildup of these contaminants in indoor air, then future indoor-air monitoring will be suspended. If the results indicate that vapor intrusion is a concern, potential mitigation options will be discussed with EPA to select the best approach for addressing that concern.”

Comment 6. *The High-Vacuum Multi-Phase Pilot Test appears to have been unsuccessful. The facility may return to manual bailing during monitoring events for removal of LNAPL as long as the results of the 2009 Indoor Air sampling support this decision.*

Response: We accept the Agency's position regarding the predicate for the return to manual bailing during the monitoring events. The following text was added to Section 6.4, page 6-6, 1st paragraph.

"If the results of paired indoor-air sampling events confirm that TCE and toluene are not impacting indoor air quality, LNAPL recovery should be done through manual bailing and toluene should remain as an analyte in the groundwater monitoring program."

Comment 7. *Regarding the Institutional Controls that the facility lists in Section 7.3 Items 1., 2., and 3: where are the stated institutional controls recorded in a signed, written document? This must be specified in the permit.*

Response: The existing Institutional Controls are recorded with the Chancery Clerk's Office of Grenada County in the State of Mississippi in Book 331 on pages 102 through 107 and Book 332 on pages 165 through 169. These pages have been added to the report in Appendix B and referenced in the text in Section 7.3, page 7-1, paragraph 1. Per EPA's comment, the recording of these and any additional Institutional Controls will be specified in the permit.

Comment 8. *EPA agrees with the additional controls proposed by the facility in Section 7.4 Recommendations.*

Response: Accepted. No changes necessary.

Comment 9. *EPA will require deed restrictions similar to those in use for the Chrome Plating Line at the Sludge Lagoon if the unit is closed with waste left in place. This will be specified in the permit.*

Response: Accepted. Because the Sludge Lagoon will be closed with the sludge stabilized in place, such deed restrictions will be specified in the permit. The following text was added as the fourth bullet in Section 7.4, page 7-2.

"4. Because the Sludge Lagoon will be closed with the sludge left in place, deed restrictions similar to those in use for the Chrome Plating Line will be established and specified in the permit."

Ms. Sharon Matthews and SEDD Comments:

Section 1: *Section 1 was a good summary of past investigations at the site and what the intended purpose of the corrective measures study is. The tasks delineated in the July 2006 "Corrective Measures Pre-Design Activities Work Plan" were covered in the February 2008 document. I agree with the recommendations given in Section 1.4. This is the information that was covered in our October 2007 meeting with the facility and their consultants.*

Response: Accepted. No changes necessary.

Section 2: *With regard to the additional non-aqueous-phase liquids delineation, I agree with the recommendation to abandon the temporary wells, but monitor existing permanent wells MW-25, MW-27, MW-28, MW-29 and MW-30. I did have one question: the PID data in Appendix A indicated hits in some of the temporary wells. Were these readings taken during drilling or were they taken while measuring the fluid levels? The readings were ranged from less than 1 ppm to greater than 1000 ppm.*

Response: The PID data in Appendix A are readings made after the wells were installed and allowed to equilibrate for NAPL measurements. The readings were made on the well headspace following removal of the j-plug caps as a health and safety precaution. Because of the non-specific nature of the PID response, the readings were not used to screen for the presence of NAPL. Interface probe measurements were made regardless of the PID readings. No changes were made to the report.

Section 3: *In this section, the vadose-zone contamination delineation in the sludge-lagoon area is discussed. Based on the information given in the report, I agree with the recommendations given in Section 3.4. The report mentions a Sludge-Lagoon Closure Plan to specify the stabilization procedure and design of the cover/cap to minimize infiltration. When will this Plan be available for review?*

Response: The Sludge-Lagoon Closure Plan will be submitted to the Agency by July 31, 2008. The plan will detail the stabilization procedure and the design of the cover/cap per the Agency's request.

Section 4: *I could not find an estimate of how many cubic feet of sludge are in the lagoon. Is this another reason the facility has opted to close in place, rather than dig out the sludge and haul it off for disposal? With regard to the contaminants in the lagoon: hadn't this information been given in past documents? MDEQ should have this info, since they granted the delisting in December 1982. According to the first paragraph of Section 4, the sludge was not a hazardous waste, so there must have been some analytical data to back this up. It appears that the sludge-stabilization tests show that closing in place is a viable option for the sludge and could reduce vadose-zone contamination impact to the groundwater. As your comment noted, if this is not a clean closure, then the sludge lagoon must be added to the Financial Assurance Plan.*

Response: The non-hazardous characteristics of the sludge, the volume and required excavation (which will be accurately calculated based on surveying results), transportation logistics and

costs, import of clean fill soil, the effectiveness of the stabilization formulation, the potential exposures to groundwater contaminants, and future land use plans were all considered in deciding to close the lagoon with the sludge in place. We plan to close the Sludge Lagoon with the sludge stabilized in place in accordance with Mississippi Commission on Environmental Quality Regulation SW-2: Nonhazardous Solid Waste Management Regulations & Criteria. The stabilized sludge will be covered, and a cap will be placed to minimize infiltration. The cap will cover the stabilized sludge and the area of soil characterized with elevated VOCs during the Corrective Measures Pre-design Investigation. Prior to completing the Sludge Lagoon Closure Plan, the lagoon area will be surveyed, and the depth and volume of sludge will be estimated. The closure plan will include details on the design and placement of the cap, as well as an estimation of the volume of sludge. Per discussions with Mr. Webster, the Sludge Lagoon costs are included in the existing Financial Assurance Plan (see Appendix A of the revised report).

***Section 5:** This scenario was discussed during the October 2007 meeting with the facility. Based on the data they gave then and in this document, the recommendations listed in Section 5.4 are adequate. And, I think your comment 5 expands on the indoor air monitoring issue and is appropriate in requesting a paired air monitoring event using the same locations as before. This would give more information on whether the Sheet Pile Barrier should ultimately be constructed.*

Response: We agree that the paired indoor air monitoring events will provide the data necessary to determine the necessity for some type of engineered vapor intrusion abatement system. We recommend conducting that sampling in August 2008 and February 2009. Please see response to Mr. Webster's Comment #5 above.

***Section 6:** Based on the recommendations given in Section 6.4, I agree that high-vacuum multiphase extraction was not as successful as had been hoped for. The use of manual bailers seems to be a good option for problem. It appears the dissolved-phase toluene may actually be beneficial in affecting the longevity of the zero-valent iron in the PRB. Is there anyone in the Atlanta office who is familiar with this concept and could comment on it?*

Response: Agreed. There have been several papers describing toluene as an electron donor to support reductive dechlorination and metals reduction, and as a cometabolite (primary substrate) in the cometabolic degradation of TCE. The following is a list of articles that describe these concepts and are provided for reference. The benefit of toluene for affecting the longevity of the zero-valent iron occurs from the depletion of oxygen, which lowers the corrosion rate of the iron.

1. JG Leahy, J.E., A.M. Byrne, and R.H. Olsen. 1996. Comparison of Factors Influencing Trichloroethylene Degradation by Toluene-Oxidizing Bacteria. Appl. Environ. Microbiol. 62: 825-833.
2. Sewell, G.W., and S.A. Gibson. 1991. Stimulation of the Reductive Dechlorination of Tetrachloroethene in Anaerobic Aquifer Microcosms by the Addition of Toluene. Environ. Sci. Technol.; 1991; 25(5); 982-984.
3. Hopkins, G.D., and P.L. McCarty. 1995. Field Evaluation of in Situ Aerobic Cometabolism of Trichloroethylene and Three Dichloroethylene Isomers Using Phenol and Toluene as the Primary Substrates. Environ. Sci. Technol. 29(6); 1628-1637.

4. Tokunaga, T.K., J. Wan, M.K. Firestone, T.C. Hazen, K.R. Olson, D.J. Herman, S.R. Sutton and A. Lanzirrotti. 2003. In Situ Reduction of Chromium(VI) in Heavily Contaminated Soils through Organic Carbon Amendment. J. Environ. Qual. 32:1641-1649.
5. Farrell, J., M. Kason, N. Melitas, and T. Li. 2000. Investigation of the Long-Term Performance of Zero-Valent Iron for Reductive Dechlorination of Trichloroethylene. Environ. Sci. Technol. 34: 514-521.
6. Wilkin, R.T., R.W. Puls, and G.W. Sewell. 2002. Long-term Performance of Permeable Reactive Barriers Using Zero-valent Iron: An Evaluation at Two Sites. EPA/600/S-02/001.

Section 7: *I don't have a copy of the permit so I can't address the institutional controls that have been implemented for this site. I will defer to your comments on this.*

Response: Please see response to Mr. Webster's Comment 7.

Section 8: *I agree with the summary of recommendations given here. With regard to your comment on Section 8.3 to further define the cap, it does need to be stated if it is an impermeable cap.*

Response: The plan is to design an impermeable cap to prevent/minimize infiltration through the stabilized sludge. Detailed design specifications will be provided in the Sludge Lagoon Closure Plan. The following text was added to Section 8.3, page 8-1.

"An impermeable cap design is planned that will likely include a 60-mL thick HDPE membrane, and a geocomposite drainage layer, 18 inches of common borrow soil, and 6 inches of soil to support grass growth. Detailed specifications and accompanying engineering drawings will be included in the Sludge Lagoon Closure Plan."

Section 9: *No comment.*

Response: Accepted

Appendices: *No comment.*

Response: Accepted

FINAL

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS
FOR
THE GRENADA MANUFACTURING FACILITY SITE
GRENADA, MISSISSIPPI

Prepared for



BROWN AND CALDWELL

4700 Lakehurst Court, Suite 100
Dublin, Ohio 43016

July 18, 2008

TABLE OF CONTENTS

LIST OF FIGURES.....	IV
LIST OF TABLES.....	IV
LIST OF ACRONYMS.....	V
EXECUTIVE SUMMARY	1
1. INTRODUCTION.....	1-1
1.1 Site History	1-1
1.2 Site Description.....	1-2
1.3 Corrective Action and Media-Specific Cleanup Objectives	1-3
1.4 Purpose	1-5
1.5 Report Outline.....	1-6
2. ADDITIONAL NON-AQUEOUS-PHASE LIQUIDS DELINEATION	2-1
2.1 Background.....	2-1
2.1.1 Main-Plant Area	2-1
2.1.2 Sludge-Lagoon Area	2-1
2.2 Approach	2-2
2.2.1 Main-Plant Area	2-2
2.2.2 Sludge-Lagoon Area	2-4
2.3 Results.....	2-5
2.3.1 Main-Plant Area	2-5
2.3.2 Sludge-Lagoon Area	2-7
2.4 Recommendations.....	2-7
2.4.1 Main-Plant Area	2-8
2.4.2 Sludge-Lagoon Area	2-9
3. VADOSE-ZONE CONTAMINATION DELINEATION IN THE SLUDGE-LAGOON AREA	3-1
3.1 Background.....	3-1
3.2 Approach	3-1
3.3 Results.....	3-2
3.4 Recommendations	3-2
4. SLUDGE SOLIDIFICATION/STABILIZATION TREATABILITY STUDY	4-1
4.1 Background.....	4-1
4.2 Approach	4-1
4.2.1 Sludge Sampling.....	4-1
4.2.2 Sludge Properties Analyses	4-2
4.2.3 Sludge-Stabilization Testing	4-3
4.3 Results.....	4-4
4.3.1 Sludge Properties Analyses	4-4

4.3.2 Sludge Stabilization Testing.....	4-4
4.4 Recommendations.....	4-7
5. SHEET-PILE BARRIER & GROUNDWATER MODELING.....	5-1
5.1 Background.....	5-1
5.2 Approach	5-1
5.3 Results.....	5-4
5.4 Recommendations.....	5-6
6. HIGH-VACUUM MULTI-PHASE-EXTRACTION PILOT TEST.....	6-1
6.1 Background.....	6-1
6.2 Approach	6-2
6.3 Results.....	6-4
6.4 Recommendations.....	6-6
7. INSTITUTIONAL CONTROLS	7-1
7.1 Background.....	7-1
7.2 Approach	7-1
7.3 Results.....	7-1
7.4 Recommendations.....	7-2
8. SUMMARY OF RECOMMENDATIONS.....	8-1
8.1 NAPL Delineation	8-1
8.2 Vadose Zone Contamination in the Sludge-Lagoon Area.....	8-1
8.3 Sludge Characterization and Treatability Testing	8-1
8.4 Sheet-Pile Barrier & Groundwater Modeling.....	8-1
8.5 High Vacuum Multi-phase Extraction.....	8-1
8.6 Institutional Controls	8-2
9. DECONTAMINATION AND INVESTIGATION-DERIVED WASTE	9-1
9.1 Site Procedures	9-1
10. LIMITATIONS	10-1
Report Limitations	10-1
11. REFERENCES.....	11-1
APPENDIX A: NAPL Well Data.....	A-1
APPENDIX B: Vadose Zone Soil Boring Summary.....	B-1
APPENDIX C: Sludge Stabilization Test Results	C-1
APPENDIX D: Financial Responsibility For Closure And Post Closure Care.....	D-1
APPENDIX E: Declaration Of Land Use Restrictions.....	E-1

LIST OF FIGURES

Figure 1-1. Site Location Map	1-1
Figure 1-2. Site Map Showing Solid Waste Management Units and Areas of Concern	1-3
Figure 1-3. Cross Section Illustrating the Site Conceptual Model	1-4
Figure 2-1. Main-Plant-Area Temporary Well Layout	2-3
Figure 2-2. Lagoon-Area Temporary Wells	2-5
Figure 3-1. Sludge-Lagoon Area Borings	3-2
Figure 4-1. Sampling Locations for the Bench-Scale Sludge-Treatability Studies.....	4-2
Figure 4-1: Proposed Sludge Lagoon Cap	4-7
Figure 5-1. Proposed Location of the Sheet-pile barrier.....	5-1
Figure 5-2. Grid Construction for Groundwater Flow Modeling	5-2
Figure 5-3. Sub-grid Area used for Transport Modeling	5-3
Figure 5-4. Calibrated Model Groundwater Elevations based on Monitoring Well Data from November 2003	5-4
Figure 5-5. Groundwater Elevation Contours Resulting from Transport Model Run with the Sheet-Pile Barrier in Place	5-5
Figure 5-6. Modeled TCE Concentrations after 30 Years.....	5-5
Figure 6-1: Existing Recovery Well Locations	6-2
Figure 6-2: HVMPE Setup: a) Existing Extraction Wells; b) Well-head Completion and Flow Control Apparatus; c) Vacuum Truck; d) Off-gas Treatment Unit.....	6-3

LIST OF TABLES

Table 1-1. Mississippi Groundwater Quality Standards.....	1-5
Table 2-1. Results from the three NAPL Measurement Events in the Main-Plant Area	2-6
Table 2-2. Water-Level and NAPL Measurements in the Sludge-Lagoon Area	2-8
Table 3-1. Vadose-Zone Soil-Boring Data and Observations.....	3-3
Table 4-1. Test Procedures.....	4-3
Table 4-2. Experimental Conditions	4-3
Table 4-3. Physical Characterization of Lagoon Sludge Samples.....	4-4
Table 4-4. Penetrometer and UCS Measurements Made 14 Days after Treatment.....	4-5
Table 4-5. Physical Properties of the Three Sludge Samples 14 Days after Reagent and Water Addition.....	4-6
Table 6-1: Historical LNAPL and Water-Level Data	6-1
Table 6-2: LNAPL Measurements in the Four Extraction Wells at the Main Plant	6-4
Table 6-3: LNAPL Extraction in Well RC-4.....	6-4
Table 6-4: LNAPL and Groundwater Levels in RC-4 after Vacuum Extraction	6-5
Table 6-5: LNAPL Measurements in the Four Extraction Wells at the Main Plant	6-5

LIST OF ACRONYMS

AOC	Area of Concern	PC	Portland Cement
AS	Alternative Standard	PCE	Tetrachloroethene
ASTM	American Society of Testing and Materials	PID	Photoionization Detector
bgs	Below Ground Surface	PMP	Project Management Plan
CFR	Code of Federal Regulations	ppm	Parts Per Million
CKD	Cement Kiln Dust	PR	Preliminary Review
CMS	Corrective Measures Study	PRB	Permeable Reactive Barrier
COC	Constituent of Concern	psi	Pounds Per Square Inch
DCA	Dichloroethane	PTW	Plant Temporary Well
DCE	Dichloroethene	QAPP	Quality Assurance Project Plan
DOT	Department of Transportation	RCRA	Resource Conservation and Recovery Act
DNAPL	Dense Non-Aqueous Phase Liquid	RFA	RCRA Facility Assessment
DTW	Depth to Water	RI	Remedial Investigation
GAC	Granular Activated Carbon	ROST	Rapid Optical Screening Tool
HSWA	Hazardous and Solid Waste Amendment	s.u.	Standard Units
HVMPE	High-Vacuum Multi-Phase Extraction	SVE	Soil Vapor Extraction
ICU	Intermediate Confining Layer	SVOC	Semi-Volatile Organic Compounds
IP	Interface Probe	SWMU	Solid-Waste Management Unit
LB	Lagoon Boring	TCA	Trichloroethane
LKD	Lime Kiln Dust	TCE	Trichloroethene
LLC	Limited Liability Company	TDS	Total Dissolved Solids
LNAPL	Light Non-Aqueous Phase Liquid	TSF	Tons Per Square Foot
LTW	Lagoon Temporary Well	UCS	Unconfined Compressive Strength
MCL	Maximum Contaminant Level	USEPA	United States Environmental Protection Agency
MIP	Membrane Interface Probe	VC	Vinyl Chloride
MW	Monitoring Well	VOC	Volatile Organic Compound
MDEQ	Mississippi Department of Environmental Quality	VSI	Visual Site Inspection
NAPL	Non-Aqueous Phase Liquid	ZVI	Zero-Valent Iron

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

EXECUTIVE SUMMARY

This Report has been prepared for the Grenada Manufacturing, LLC facility (Site) located at 635 Highway 332 in Grenada, Mississippi. The facility is undergoing Resource Conservation and Recovery Act (RCRA) corrective action for releases of hazardous waste, including hazardous constituents, from various Solid Waste Management Units (SWMUs). This report provides results from the activities outlined in the Corrective Measures Pre-Design Activities Work Plan (Work Plan), along with recommendations for further actions at the Site.

The Work Plan described a suite of Site-specific actions that included:

- investigation to locate/delineate non-aqueous-phase liquids (NAPLs) in the Main-Plant Area (Areas of Concern (AOCs) A and B) and at the Sludge Lagoon (SWMU 4)
- delineation of vadose-zone contamination at the Sludge Lagoon
- solidification/stabilization treatability testing on sludge from the Sludge Lagoon
- evaluating the impact of installing sheet pile up gradient of AOCs A and B for groundwater migration control
- conducting a high-vacuum multi-phase-extraction (HVMPE) pilot test to evaluate potential for enhanced light non-aqueous-phase liquid (LNAPL) removal at AOC B
- evaluating existing and implementing additional institutional controls to minimize risks to on-site workers at the Site.

Investigating for the presence of NAPLs included installation of 31 direct-push temporary dense non-aqueous-phase liquid (DNAPL) detection wells in the Main-Plant Area, five of which are combination wells designed to detect both LNAPL and DNAPL. Nine temporary well couplets were installed in the Sludge-Lagoon Area, each couplet consisting of one deep and one shallow well for DNAPL and LNAPL detection, respectively. The wells in the Main-Plant Area and the Sludge-Lagoon Area were checked for NAPL during three events conducted over a four-month period. None of the wells in either area contained NAPL during any of those events. Five permanent monitoring wells (MWs) previously installed in the Main-Plant Area were also checked for NAPL, with the same result of no measurable NAPL during the three monitoring events. Based on these findings, it is recommended that the temporary wells in the Main-Plant Area be abandoned according to Mississippi requirements, and that NAPL monitoring in this area consist of sampling the permanent monitoring wells on a biennial basis for an additional four years. Recommendations for the sludge lagoon include stabilization and capping of the lagoon, which is discussed in detail below.

Vadose-zone contamination in the Sludge-Lagoon Area was delineated by direct-push coring around the perimeter of the lagoon using a Geoprobe® rig, and conducting headspace analyses of the samples using a photoionization detector (PID). The results delineated the contamination and showed that the majority of the contamination was confined to the lagoon proper. The exception was in two areas where the contamination extended beyond the originally proposed boundary for the lagoon cover. The recommendation is to extend the cover to include the additional area delineated under this investigation.

Pre-design activities for the Sludge Lagoon closure included bench-scale testing of mixtures of stabilizing agents. Sludge samples were collected from three discrete areas in the lagoon, sent to the laboratory, and mixed with various combinations of Type I Portland cement (PC), hydrated lime (HL), lime-kiln dust (LKD),

and cement-kiln dust (CKD). The materials were mixed, allowed to set up, and then analyzed for various physical/chemical properties including unconfined compressive strength, volume expansion, and one-dimensional consolidation. Test results showed PC and LKD sufficiently stabilized the sludge, and that the need to dewater would be limited to the northwest portion of the Sludge Lagoon. Based on the findings, and on the anticipated weight of the cover and the equipment anticipated for mixing the reagents with the sludge and earthmoving, it is recommended that the sludge be stabilized to a unified compressive strength (UCS) of 12-15 pounds per square inch (psi).

Installation of a sheet-pile barrier in the Main-Plant Area had been proposed in the CMS as a possible means for controlling contaminant migration from the source area. The effects of installing a sheet-pile barrier were modeled using MODFLOW and MT3D. Model simulations were run with, and without, the barrier in place showed little difference in contaminant migration and/or plume longevity. The permeable reactive barrier (PRB) was designed to treat the contaminants based on the concentration profile without the sheet pile in place, and any disruption in the contaminant or groundwater flux to the barrier would result in suboptimal performance. As such, it is recommended that the sheet-pile barrier not be installed to allow the PRB to operate as designed.

A high-vacuum multi-phase-extraction (HVMPE) pilot test was conducted in October 2007. The test apparatus was sequentially connected to two existing extraction wells located in AOC B that contained measurable LNAPL at the time of the test. The high vacuum in the extraction apparatus imparted a much smaller vacuum on the well, and LNAPL recovery was largely limited to the material that was contained in the well casing at system startup. The vacuum caused the water table to rise at the extraction well, indicating a limited radius of influence and vapor/fluid flow. It was determined that the applied vacuum provided no enhancement to LNAPL recovery from the well. Accordingly, the technology was deemed inappropriate for LNAPL removal at this location. Additionally, sampling down gradient of AOC B has never shown toluene to be above the EPA MCL, indoor air monitoring at the Main Plant Building has never indicated the presence of volatile organic compounds (VOCs) at concentrations of concern, and the toluene appears to be contributing to some level of "natural attenuation" of the chlorinated solvents and metals, regulating their concentrations across the site (and in particular at the PRB). Based on the ineffectiveness of the HVMPE shown by the pilot test and the above mitigating factors, it is recommended that HVMPE not be pursued at the Site.

Institutional controls currently in place to limit access and/or exposure to contamination include a lock and key control program for the perimeter fences and monitoring wells, warning signs posted around the Site, and deed restrictions limiting activities that could encounter subsurface contamination including well installation, groundwater usage, and surface and subsurface demolition and excavation. The deed restrictions also limit the property use to industrial and grant the United States Environmental Protection Agency (USEPA), Mississippi Department of Environmental Quality (MDEQ) unlimited access to the Site. After reviewing the existing control, it is recommended that additional signs to include "No Digging" signs be posted along the length of the PRB, and that warning signs should be posted along the fences around the Sludge-Lagoon Area during stabilization and capping work. Afterwards, it is recommended that signs be posted to encourage caution and warn against digging in that area. The existing property use restrictions are considered "interim" in nature and should be readdressed following implementation of all of the corrective measures.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

1. INTRODUCTION

1.1 Site History

The entities formerly comprising the Automotive division of Rockwell International Corporation, which are now, through a series of corporate transactions and restructurings, a part of ArvinMeritor, Inc., owned and operated a wheel-cover manufacturing facility in Grenada, Mississippi (Figure 1-1). The facility operated from 1966 to 1985, before the operations and property were sold to Textron Automotive Company, formerly Randall Textron. In 1999, Textron Automotive Company sold the operations and property to Grenada Manufacturing, LLC, who continues to operate the wheel cover plant.

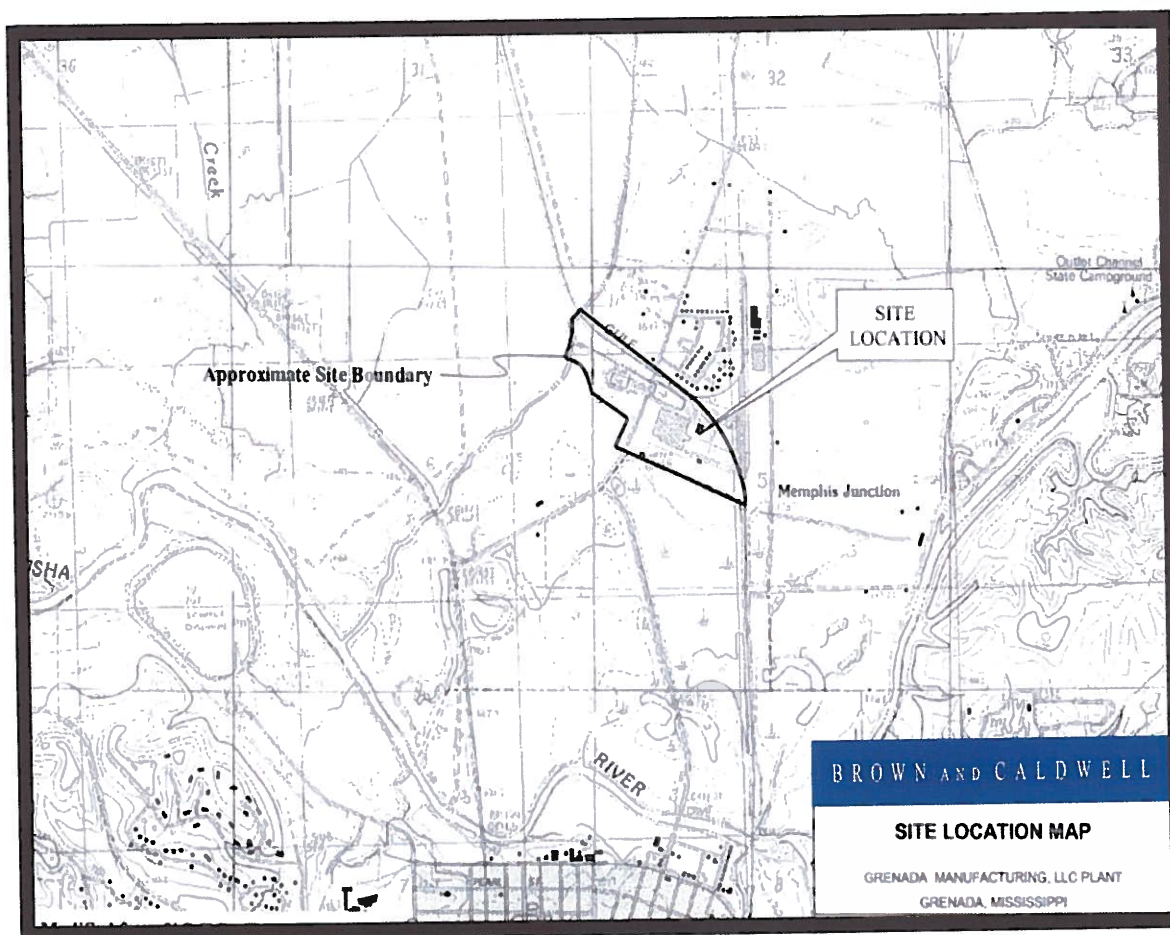


Figure 1-1. Site Location Map

ArvinMeritor and Textron have conducted a number of environmental investigations at the referenced facility (hereafter referred to as the Site). The 1994 Remedial Investigation (RI) Report detailed sampling and

analyses of soil, surface water, sediment, and groundwater at the facility. The report contained a description of the Site, including its geology and hydrogeology, as well as the sampling and analytical work that was performed. Results from the investigation were discussed on a site-wide basis, because SWMUs and AOCs had not yet been defined. In addition to soil and groundwater impacts, two areas containing free-phase organics, light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL), were identified.

The RI identified the presence of trichloroethylene (TCE) and its degradation products, as well as toluene and chromium, in the soil and groundwater at the Site. A Baseline Risk Assessment was performed for soil and groundwater as part of a Supplemental RI (March 1994). The primary concern with respect to impacted groundwater was the migration of chlorinated volatile organic compounds (VOCs) to Riverdale Creek on the western side of the Site. The Baseline Risk Assessment identified eight VOCs (1,2-dichloroethane (1,2-DCA), 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethene (1,2-DCE) (total), tetrachloroethene (PCE), toluene, 1,1,2-trichloroethane (1,1,2-TCA), TCE, and vinyl chloride (VC)), one semi-volatile organic compound (SVOC) (bis(2-ethylhexyl) phthalate), and two metals (hexavalent chromium and arsenic) as constituents of concern (COCs).

Subsequent to the submittal of the 1994 RI Report, the facility became subject to regulation under the RCRA. Between 1996 and 1997, USEPA performed a RCRA Facility Assessment (RFA) as part of the HSWA permit process for the Site. The Preliminary Review (PR) and Visual Site Inspection (VSI) identified 26 SWMUs and 3 AOCs.

In 1998, ArvinMeritor collected another set of groundwater samples to measure VOC concentrations, and to evaluate the potential for natural attenuation. The measured parameters included those recommended in USEPA's document "Technical Protocol for Evaluating Monitored Natural Attenuation of Chlorinated Solvents in Ground Water" (USEPA, 1998). The data were presented in a January 1999 report titled "Supplemental Groundwater Sampling and Analysis: Natural Attenuation Evaluation." The evaluation established that natural attenuation was reducing the quantities of chlorinated solvents in Site groundwater.

In January 2001, after submittal and approval of the June 2000 Interim Measures Work Plan, a draft RCRA Facility Investigation Report was prepared and submitted to USEPA and MDEQ. The Report was revised in October 2001, and included results of site-wide sampling for VOCs, SVOCs, and other contaminants. In August 2003, a CMS Report that summarized work completed at the Site, specified installation of a zero-valent-iron (ZVI) PRB as the Site's remediation technology, and outlined potential additional remedial measures, was submitted to USEPA and approved. Construction of the PRB was completed in the spring of 2005, and a performance monitoring program has been in place since then. In July 2006, a Corrective Measures Pre-Design Work Plan (Work Plan) was prepared based on the recommendations made in the CMS Report. The Work Plan defined additional site investigations required to further evaluate the need for the additional corrective measures specified in the CMS Report, and to design those measures deemed necessary. The Work Plan was submitted to USEPA and approved. The investigations have been completed and the approaches, results, and recommendations are provided in Sections 2 through 7 of this report.

1.2 Site Description

The Site includes a number of solid-waste management units (SWMUs) and AOCs, as shown on Figure 1-2. The different areas have been defined by various past and ongoing operations at the manufacturing facility and as such are characterized with different contaminants and different remedial needs. The CMS addressed each area accordingly and the pre-design activities described in this report are discussed based on the specific area for which they are included.

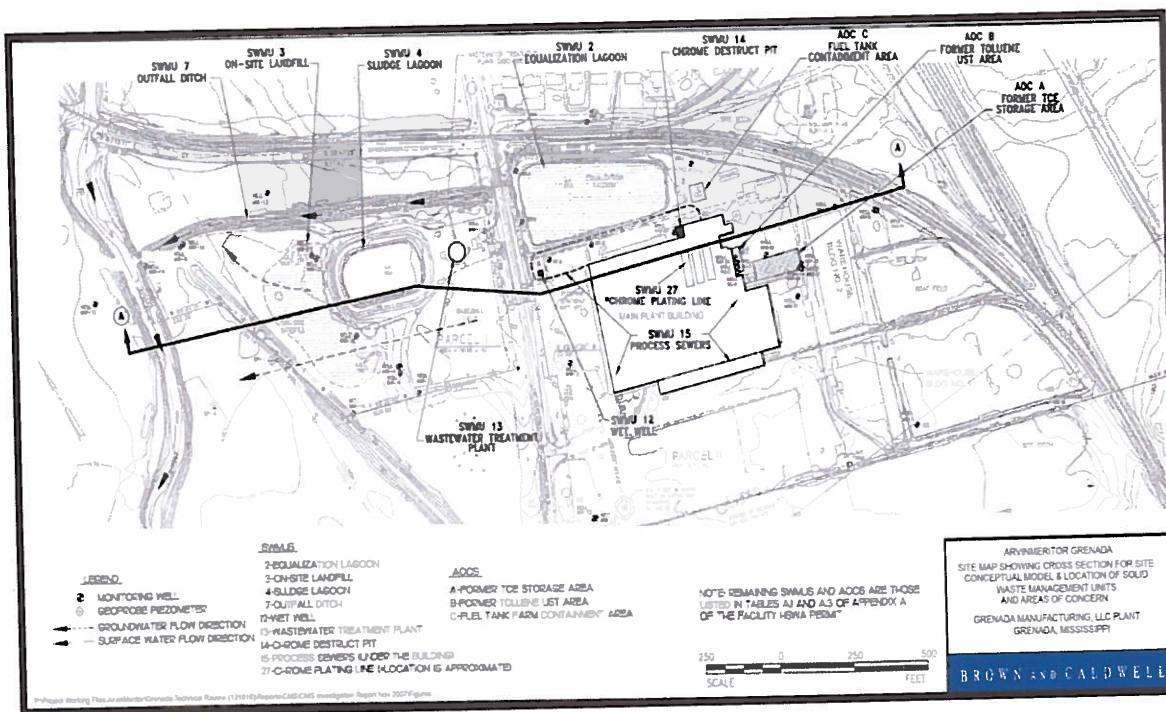


Figure 1-2. Site Map Showing Solid Waste Management Units and Areas of Concern

Figure 1-3 shows a generalized cross section along the length of the Site parallel to the general direction of groundwater flow. The stratigraphy at the Site is comprised of approximately 8 to 15 feet of clayey silt or silty clay overlying approximately 30 to 50 feet of saturated, fine- to medium-grained sands that contain varying amounts of silt. Combined, these soils are referred to as the “upper aquifer.” Within the vicinity of the Main Plant, the sand unit is bisected by a discontinuous clay unit at a depth between 20 and 30 feet. This clay unit was not observed in the western portion of the Site or in the vicinity of the PRB. At the base of the sand unit is a thinly-bedded, slightly-sandy, clayey silt, which is encountered at depths ranging from 47 to 60 feet below ground surface (bgs) and serves as an intermediate confining unit (ICU) that acts as an aquitard and separates the upper and lower aquifers. This layer is approximately 16 feet thick and has been identified as marl exhibiting much higher blow counts than the overlying soils. Below this unit is another sand layer that comprises the “lower aquifer.”

The Upper Aquifer is the primary horizontal transport pathway for the Site. Groundwater in this aquifer is generally under semi-confined conditions, flows to the northwest, and discharges into Riverdale Creek. It is believed that Riverdale Creek is in direct communication with the Upper Aquifer. The Upper Aquifer is semi-confined above by the surficial confining unit and below by the lower clay unit. A significant upward gradient exists between the Upper and Lower Aquifers, thereby precluding the transport of constituents of concern to the Lower Aquifer from the Site. No impact has been identified in the lower aquifer.

1.3 Corrective Action and Media-Specific Cleanup Objectives

In broad terms, the corrective action strategy for this site is to protect human health and the environment from the effects of releases of hazardous waste or hazardous constituents. The Baseline Risk Assessment for

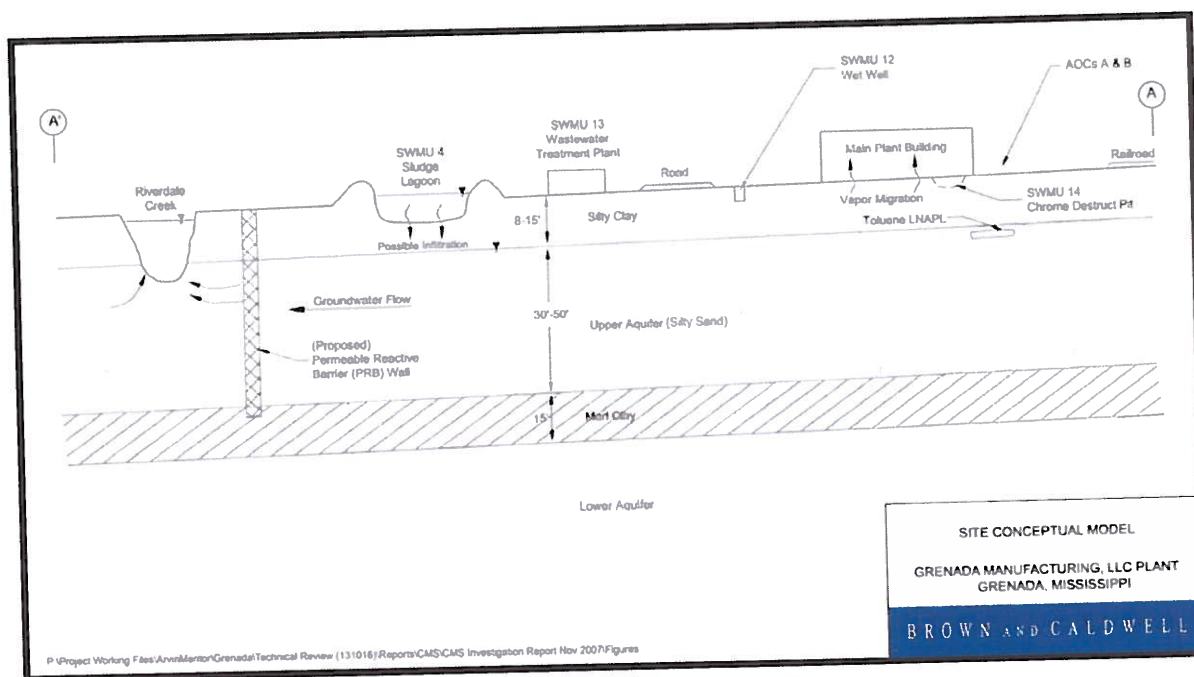


Figure 1-3. Cross Section Illustrating the Site Conceptual Model

the Grenada Manufacturing property established that, with the exception of one potential scenario, the Site did not pose unacceptable human health risks to potential current or future receptors; that is, the potential carcinogenic risks were all below 10^{-4} (1 in 10,000), and the potential non-carcinogenic hazard risks were all less than 1.0. The singular exception was the hypothetical future use of the uppermost aquifer as a drinking water supply. The use of this aquifer as a drinking-water source is unlikely considering that the current and likely future use of the Site is industrial. Nonetheless, one of the key concepts of EPA's groundwater protection strategy is to "make progress toward the ultimate goal of returning contaminated groundwater to its maximum beneficial use."

MDEQ has promulgated state-wide numerical groundwater quality standards which apply to all aquifers with a Total Dissolved Solids (TDS) concentration of less than 10,000 mg/L and which are capable of yielding an adequate volume of water to serve the potable water needs of an average residence using standard well construction and pumping technology. The affected aquifer at the Grenada Manufacturing site falls within the TDS and yield parameters. The Mississippi standards are equivalent to the Maximum Contaminant Levels (MCLs) promulgated by USEPA as primary drinking water standards. For chemicals with no promulgated MCL, MDEQ has set forth a calculation procedure for deriving groundwater quality standards. For remedial purposes only, the MDEQ may establish an Alternative Standard (AS) based upon human health criteria and lifetime cancer risk of 1 in 10,000 or less. The Mississippi standards are shown in Table 1-1.

Several principal actions are outlined in the CMS to control exposure and migration of the contamination at the Site. These actions take into consideration site characteristics, land use, current conditions, and previous and on-going source control measures. The following actions are included in the CMS.

1. Implement corrective measures that are protective of human health and the environment based upon current potential exposures.

2. For affected groundwater that has migrated beyond the facility boundary (down gradient of the PRB), clean up to Mississippi groundwater quality standards.
3. Prevent further degradation of soil and groundwater with appropriate source control corrective measures. Utilize the PRB as a site-wide migration control measure.
4. Comply with standards for management of waste during corrective measure implementation.
5. Develop and implement use restrictions/institutional controls for site soil and groundwater to prevent future exposures.
6. Implement the approved Performance Monitoring Plan to track the progress of the corrective action program.

Table 1-1. Mississippi Groundwater Quality Standards

Chemical	Standard ^a (µg/L)
Chromium	100
1,2-Dichloroethane	5
1,1-Dichloroethylene	7
<i>cis</i> -1,2-Dichloroethylene	70
Tetrachloroethylene	5
Toluene	1,000
1,1,2-Trichloroethane	5
Trichloroethylene	5
Vinyl Chloride	2

^a These are equivalent to the federal MCLs published in 40 CFR 141.

The final cleanup goals suggested in the CMS for this facility are the Mississippi groundwater quality standards. The logical point of compliance defined in the CMS is groundwater immediately down gradient of the PRB.

1.4 Purpose

The purpose of this report is to describe investigative activities conducted under the Pre-Design Investigation Work Plan to evaluate the need for, and design of, several measures identified in the CMS. The report discusses the results of those activities and provides recommendations for moving forward on the remedial program as recommended in the CMS Report. The Work Plan activities included:

- investigation into the presence of NAPLs in the Main-Plant Area (AOCs A and B) and at the Sludge Lagoon (SWMU 4)
- delineation of vadose-zone contamination at the Sludge Lagoon
- bench-scale testing various combinations of solidification/stabilization mixtures on sludge from the Sludge Lagoon
- modeling the impact of a sheet-pile barrier placed up gradient of AOCs A and B
- pilot testing a high-vacuum multi-phase-extraction system for enhanced LNAPL removal at AOC B
- evaluating existing institutional controls and implementing additional measures as needed to minimize risks to on-site workers at the Site.

In addition, excavation and ex-situ soil-vapor extraction (SVE) would be considered as a contingent corrective measure for the Sludge Lagoon if the sludge characteristics did not meet certain criteria for effective implementation of the stabilization and capping/cover system.

The actions listed above have been implemented, and this report provides the methods and findings of these investigations. This report also provides a detailed review of other completed and ongoing work at the Site.

1.5 Report Outline

The remaining sections of this report describe the methods used for the various corrective measure pre-design investigations, the results obtained from those investigations, and recommendations for further action where needed. Each of the following report sections covers one of the Work Plan activities listed in Section 1.4, and the order in which they are listed above is the order in which they appear in the subsequent sections of the report. In each section, background information is provided for the specific area and the issue at hand, followed by the approach, the results and discussion, and finally the recommendations. The final section of this report summarizes the recommendations for further actions from each of these six activity areas.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

2. ADDITIONAL NON-AQUEOUS-PHASE LIQUIDS DELINEATION

2.1 Background

In the Work Plan, additional NAPL delineation was proposed at the Main-Plant and Sludge-Lagoon Areas to assess improvements to existing NAPL recovery efforts. The area-specific details and the work activities completed in these areas are described in the following sections.

2.1.1 Main-Plant Area

An automated DNAPL recovery system installed in October 1993 at the Former TCE Storage Tank (AOC A) operated for approximately three years, during which time more than 200 gallons of DNAPL were recovered. Toward the end of the three years, the DNAPL recovery rate dropped off to the point where the system was no longer effective, and the system was removed. Between 1996 and 2003, additional DNAPL was manually removed from the extraction wells. The DNAPL volumes removed from the wells between 1996 and 2000 were not recorded. Between 2000 and 2003, approximately 39 gallons of DNAPL were recovered. Based on the recovery of a significant quantity of DNAPL from the single well in AOC A, it was considered possible that additional DNAPL might be recoverable from other locations in the area.

The Work Plan specified installation of up to 30 direct-push DNAPL-investigation wells in the source area to determine if additional recoverable DNAPL was present in AOC A. The wells were to be 45 to 55 feet deep and screened across the lowest five feet of the saturated zone to include the interface between the formation sand and the marl. The wells were to extend one to two feet into the marl to create a sump in which DNAPL could accumulate. Data gathered during installation were to delineate the surface contours of the clay and potentially guide placement of additional wells. If necessary, a rapid optical screening tool (ROST™) or membrane interface probe (MIP) would have been used for further NAPL delineation.

2.1.2 Sludge-Lagoon Area

The Sludge Lagoon was previously used as a retention basin for solids from chemical precipitation at the wastewater treatment plant. The Sludge Lagoon is no longer active and is being addressed as part of the CMS. The 2001 RCRA Facility Investigation Report indicated the presence of NAPL in MW-2. Water sampled from MW-2 in October 1998 measured 650 mg/L TCE. Fifteen attempts to measure DNAPL in MW-2 between February 2004 and July 2005 found the well to be dry each time. No further NAPL recovery efforts have been made at MW-2.

The Work Plan proposed direct push installation of up to ten temporary well couplets to determine the presence of NAPLs. Each couplet was to include a shallower well to detect LNAPL, and a deeper well to detect DNAPL. The LNAPL wells were to be completed between 20 and 25 feet bgs, with 10-foot screens placed across the water table. The DNAPL wells were to be completed to depths between 45-55 feet bgs, with 1-foot long screens placed at the bottom so as to include the interface between the formation sand and the hardpan clay. ROST™ or MIP systems were to be deployed as needed to further delineate detected NAPLs.

2.2 Approach

Brown and Caldwell subcontracted Envirocore, Inc. to provide drilling and well installation services in the Sludge-Lagoon and Main-Plant Areas under the supervision of a BC Geologist. A Geoprobe® Model 6600 direct push drill rig mounted on a Ford 550 chassis was used to complete the work. For those borings and temporary NAPL detection wells installed in the Sludge-Lagoon Area, a Bobcat T250 Turbo skid steer was used to clear brush and position the Geoprobe® drill rig in wet and muddy areas.

Based on previous investigations conducted at the site, it was determined that Geoprobe® refusal reflects the top of the Intermediate Confining Unit (ICU), referred to during this investigation as the “hardpan clay.” DNAPL, if present, would be expected to accumulate atop this hardpan clay, or any softer clay immediately above the hardpan clay that is still part of the ICU. Therefore, drilling refusal was relied upon, with periodic confirmation sampling, as the primary means to establish well depth for the temporary DNAPL detection wells.

Temporary wells were installed using 4-foot lengths of 3.25-inch I.D. drill rods. An expendable stainless steel drill tip was used at each location. Once the rods were advanced to the appropriate depth, the well screens and casing sections were assembled and lowered into the drill rods. The temporary wells were constructed of 2-inch I.D., Schedule 40 PVC well casings and a 0.01-inch slot screen section. A threaded well cap was installed on the bottom of each well. The well materials were placed into the drill rods and held in place as the drill rods were pulled up from the ground, dislodging the expendable tip and leaving the bottom of the well at the target depth. For the temporary DNAPL detection wells, approximately 10 gallons of potable water was added to the well to add weight and assist in dislodging the expendable tip prior to pulling the drill rods. Once the drill rods were removed, the formation sands were allowed to collapse in around the screen and casing. Any portion of the annular space that did not collapse on its own was backfilled to above the top of the screen with clean sand, and then to ground surface with bentonite chips. For borings where no well materials were installed, the borehole was backfilled completely with bentonite chips.



2.2.1 Main-Plant Area

Thirty-one temporary DNAPL detection wells were installed at the Main-Plant Area. The locations of those wells are shown in Figure 2-1. Thirty of the wells were installed on 30-foot centers in a grid pattern in between the Main-Plant Building, the warehouse, and Building No. 3. The grid included five rows oriented approximately north to south (identified as rows A through E) and six columns oriented approximately west to east (identified as columns 1 through 6). The temporary wells were labeled PTW-A1 through PTW-E6. The 31st temporary well was installed approximately 30 feet to the north, and in between, wells PTW-A5 and PTW-A6. That well was labeled PTW-AA5.

Twenty-six of the 31 wells consisted of five feet of well screen at the bottom of the well and solid well casing to the surface. The remaining five wells, located adjacent to the Main-Plant building (PTW-A1, B1, C1, D1 and E1), were screened from the bottom of the well to 2 to 3 feet below ground surface (bgs). These wells were designed to allow measurement of dissolved-phase volatile organic compounds (VOCs) in groundwater down gradient of the source area and to measure the flux of dissolved-phase contaminant(s) from AOC A.

Slots were cut in the sides of the well plugs on all 31 temporary wells to add approximately 0.4 feet to the effective length of screen, and to ensure that each well was screened into the clay hardpan. Wells placed in unpaved non-traffic areas were finished as “stickup” wells and were fitted with lockable J-plugs. The wells completed in paved or high traffic areas were completed below grade to protect the wells and allow for future access. The casing for each of those wells was cut off at approximately four inches below grade. Expandable pipe plugs were inserted into the well casing and the upper six inches of the annular space was backfilled with pea gravel.

Soil-core samples were collected from two locations in the Main-Plant Area to verify that the depth of refusal of the drill rods correlated with the depth of the hardpan clay. The boring associated with PTW-C6 was continuously sampled to a depth of 56 feet, and the boring associated with PTW-E1 was sampled from depths of 25 to 35 feet and from 50 to 55 feet. The cores collected from these borings found approximately

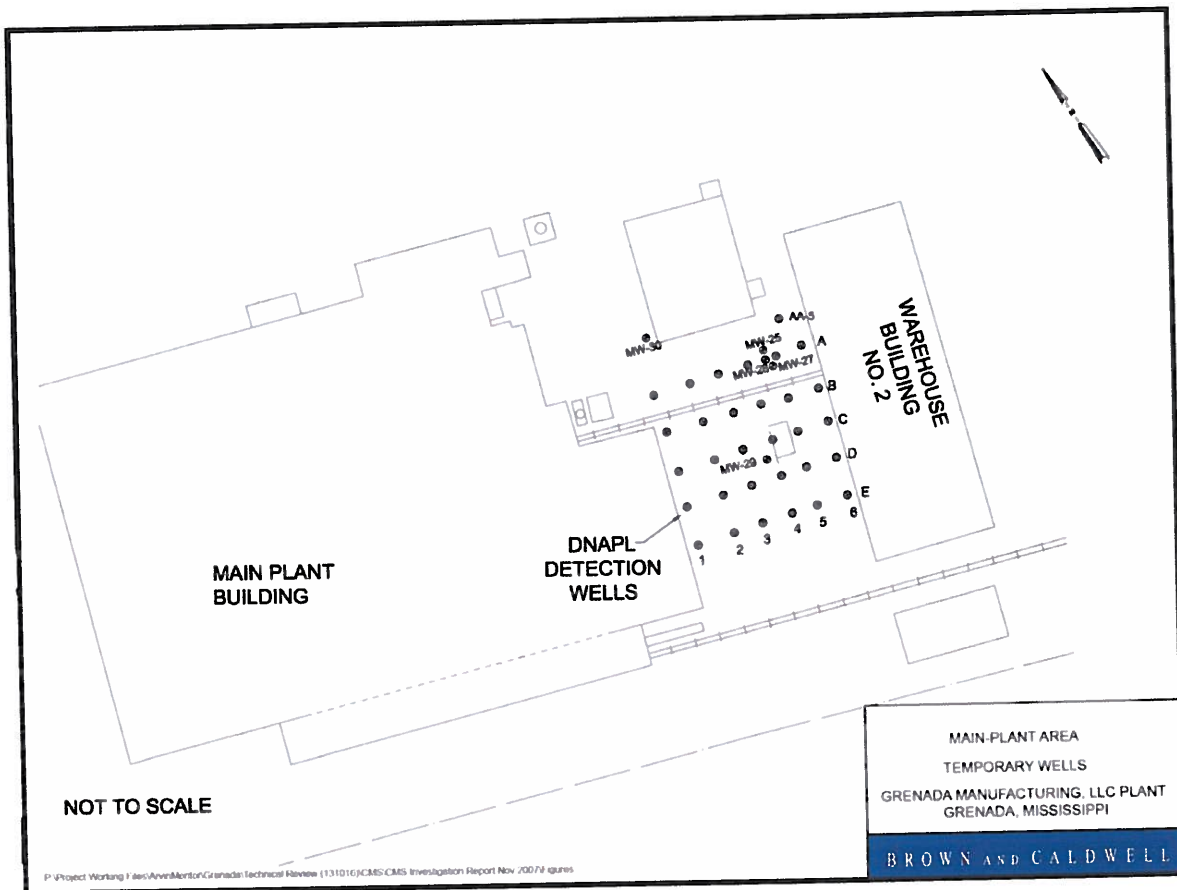


Figure 2-1. Main-Plant-Area Temporary Well Layout

two feet of soft clay present on top of the hardpan clay. Encountering this clay did not result in refusal of the drill rod. DNAPL, if present, would be expected to accumulate on top of this softer clay. The core samples also verified the presence of a shallower clay lens, located below the water table and along the eastern side of the area. The lens pinched out and was not present further to the west. This finding was consistent with previous investigations.

Fluid levels were measured in each of the temporary wells and existing monitoring wells located in the general vicinity. An ORS or Solinst interface probe (IP) was used to measure the depths to the water table and the depth to the interface between groundwater and measurable DNAPL. The probe was lowered into the well until the instrument indicated detection of LNAPL or groundwater and the depth reading on the lead wire was recorded off of the top of the well casing. The probe was then further lowered into the well until the probe indicated that DNAPL was encountered, or until the probe reached the bottom of the well. If the probe indicated DNAPL, the depth at which the instrument responded was recorded. The total depth of the well was determined as the depth at which the probe bottomed out.

2.2.2 Sludge-Lagoon Area

Nine temporary NAPL-detection well couplets were installed around the perimeter of the Sludge Lagoon as shown in Figure 2-2. Inclement weather conditions in July made the ground very soft, and maneuvering the Geoprobe® rig was extremely difficult. As a result, nine well couplets were installed in selected locations that provided adequate coverage around the lagoon to find and delineate the presence of NAPLs.

Each well couplet included a shallow LNAPL detection well that was completed with 10 feet of 0.01-inch slot well screen placed across the water table, and a DNAPL detection well consisting of approximately 10 feet of 0.010-slot well screen installed on top of the underlying hardpan clay. The bore hole associated with temporary DNAPL detection well LTW-8 was continuously sampled to the depth of refusal (i.e., when the hardpan clay was encountered) to verify that depth of drill-rod refusal corresponded to the top of the aquitard. The temporary wells were labeled LTW-1 through LTW-18, with the odd numbered wells representing the shallower LNAPL detection wells and the even numbered wells representing the deeper DNAPL detection wells. All temporary NAPL detection wells installed in the Sludge-Lagoon Area were completed as “stickups” and fitted with lockable J-plugs. Although it was originally intended to place the DNAPL wells into the hardpan to form a sump to collect DNAPL, it was discovered that the clay could not be penetrated to any significant depth to form a sump. To compensate for this, slots were cut into the well plugs to allow any DNAPL to enter the very bottom of the wells. This added approximately 0.4 feet to the effective screen length and placed the lower slots immediately above the clay, allowing detection of very thin DNAPL layers if they were present on the aquitard surface.

Fluid levels (LNAPL, groundwater, and DNAPL) were measured in the wells in July, August, and October of 2007. Fluid-level measurements were made to detect the presence of NAPLs and, if present, to establish the depth to and thickness of those liquids. The depths were measured using an ORS or Solinst IP in the same manner followed in the Main-Plant Area as described previously.



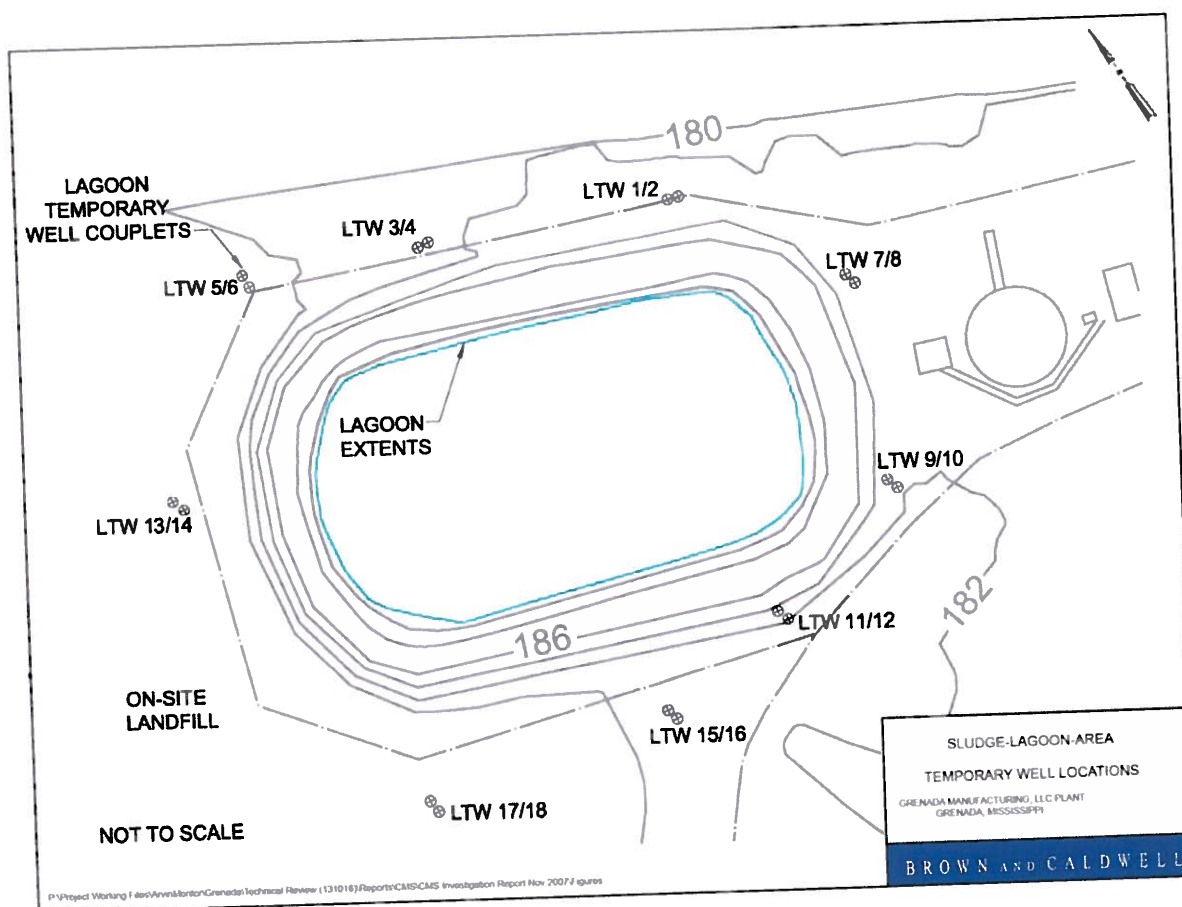


Figure 2-2. Lagoon-Area Temporary Wells

2.3 Results

The results from the NAPL investigations in the Main-Plant and Lagoon Areas are presented and discussed in the following sections. Data tables from these investigations can be found in Appendix A.

2.3.1 Main-Plant Area

Depth to water and depths of NAPL detections from the wells in the Main-Plant Area are provided in Table 2-1. The depth to water, based on measurements made in the 31 plant temporary wells (PTWs), increased over the course of the four months, with average depths of 9.82, 10.33, and 10.71 feet bgs for the July, August, and October measurements, respectively. The depths to groundwater measured in the four permanent monitoring wells fell within the range of depths measured at the PTWs.

No LNAPL or DNAPL was detected in any of the 31 PTWs during the three measurement events that spanned a 4-month time period. Of the four permanent monitoring wells that were included in the measurement activities, only MW-26 and MW 28 indicated the possibility of LNAPL in the well, with the IP producing a signal during each of the three events. Confirmation sampling using a Teflon bailer proved that the signal was a false positive as the recovered sample contained sediment, but no NAPL.

Table 2-1. Results from the three NAPL Measurement Events in the Main-Plant Area

Well ID	Depth to Water (feet bgs)	Top of DNAPL (feet bgs)	Well ID	Top of LNAPL (feet bgs)	Depth to Water (feet bgs)	Top of DNAPL (feet bgs)
July 2007						
PTW-A1	9.35	ND	PTW-C5	ND	9.86	ND
PTW-A 2	9.09	ND	PTW-C6	ND	11.28	ND
PTW-A 3	9.02	ND	PTW-D1	ND	9.19	ND
PTW-A 4	8.98	ND	PTW-D2	ND	9.49	ND
PTW-A 5	8.96	ND	PTW-D3	ND	9.05	ND
PTW-A 6	10.92	ND	PTW-D4	ND	9.10	ND
PTW-B1	9.39	ND	PTW-D5	ND	9.83	ND
PTW-B2	9.36	ND	PTW-D6	ND	11.67	ND
PTW-B3	9.45	ND	PTW-E1	ND	9.17	ND
PTW-B4	9.55	ND	PTW-E2	ND	8.95	ND
PTW-B5	12.42	ND	PTW-E3	ND	9.12	ND
PTW-B6	10.83	ND	PTW-E4	ND	9.42	ND
PTW-C1	9.40	ND	PTW-E5	ND	11.26	ND
PTW-C2	9.22	ND	PTW-E6	ND	11.55	ND
PTW-C3	8.92	ND	PTW-AA5	ND	11.59	ND
PTW-C4	9.03	ND	MW-25	**	**	**
MW-27	9.23	ND	MW-28	ND	9.05	ND
MW-29	**	**	MW-30	**	**	**
August 2007						
PTW-A1	9.86	ND	PTW-C5	ND	10.38	ND
PTW-A 2	9.54	ND	PTW-C6	ND	11.85	ND
PTW-A 3	9.57	ND	PTW-D1	ND	9.70	ND
PTW-A 4	9.50	ND	PTW-D2	**	**	**
PTW-A 5	9.50	ND	PTW-D3	**	**	**
PTW-A 6	11.46	ND	PTW-D4	**	**	**
PTW-B1	9.90	ND	PTW-D5	ND	10.36	ND
PTW-B2	9.91	ND	PTW-D6	ND	12.21	ND
PTW-B3	9.96	ND	PTW-E1	ND	9.70	ND
PTW-B4	10.12	ND	PTW-E2	**	**	**
PTW-B5	10.07	ND	PTW-E3	ND	9.64	ND
PTW-B6	11.38	ND	PTW-E4	ND	9.99	ND
PTW-C1	9.92	ND	PTW-E5	ND	11.55	ND
PTW-C2	9.71	ND	PTW-E6	ND	12.08	ND
PTW-C3	9.40	ND	PTW-AA5	ND	12.12	ND
PTW-C4	9.66	ND	MW-25	ND	9.30	ND
MW-27	9.76	ND	MW-28	ND	9.58	ND
MW-29	9.42	ND	MW-30	ND	9.78	ND

Well ID	Depth to Water (feet bgs)	Top of DNAPL (feet bgs)	Well ID	Top of LNAPL (feet bgs)	Depth to Water (feet bgs)	Top of DNAPL (feet bgs)
October 2007						
PTW-A1	10.30	ND	PTW-C5	ND	10.80	ND
PTW-A 2	9.55	ND	PTW-C6	ND	12.25	ND
PTW-A 3	9.99	ND	PTW-D1	ND	10.39	ND
PTW-A 4	9.91	ND	PTW-D2	**	**	**
PTW-A 5	9.92	ND	PTW-D3	**	**	**
PTW-A 6	11.90	ND	PTW-D4	ND	9.60	ND
PTW-B1	10.36	ND	PTW-D5	ND	10.74	ND
PTW-B2	10.30	ND	PTW-D6	ND	12.64	ND
PTW-B3	10.34	ND	PTW-E1	ND	10.15	ND
PTW-B4	10.49	ND	PTW-E2	ND	--	ND
PTW-B5	10.58	ND	PTW-E3	ND	--	ND
PTW-B6	11.79	ND	PTW-E4	ND	10.38	ND
PTW-C1	10.19	ND	PTW-E5	ND	11.71	ND
PTW-C2	10.17	ND	PTW-E6	ND	12.51	ND
PTW-C3	9.73	ND	PTW-AA5	ND	12.53	ND
PTW-C4	9.90	ND	MW-25	ND	9.74	ND
MW-27	10.19	ND	MW-28	9.99	10.14	ND
MW-29	10.30	ND	MW-30	10.14	10.14	ND

ND – not detected

** - well was not accessible

2.3.2 Sludge-Lagoon Area

The depth to water and depths to detections of LNAPL and DNAPL measurements made in the 9 LNAPL and 9 DNAPL lagoon temporary wells (LTWs) around the perimeter of the Sludge-Lagoon during the three measurement events are provided in Table 2-2. The depths to water measured in the nine LNAPL LTWs averaged 12.98, 13.74, and 14.10 feet bgs during the July, August, and October measurement events, respectively. These measurements indicated that on average, the water table in the Sludge-Lagoon Area dropped 1.12 feet over the four months of measurements. The depths to water in the nine DNAPL LTWs averaged 13.29, 14.24, and 14.35 feet bgs for the same three respective measurement events, indicating an average drop in piezometric head of 1.06 feet during the same monitoring period. Comparing the averaged data between the LNAPL and DNAPL wells indicated the presence of a consistent downward gradient in the Sludge-Lagoon Area between July and October, 2007.

There were no detections of either LNAPL or DNAPL in any of the respective LTWs over the course of the four months.

2.4 Recommendations

The following two subsections provide recommendations based on the outcomes of the NAPL investigations in the Main-Plant Area and the Sludge-Lagoon Area.

Table 2-2. Water-Level and NAPL Measurements in the Sludge-Lagoon Area

LNAPL LTWs			DNAPL LTWs		
Well ID	Depth to LNAPL (feet bgs)	Depth to water (feet bgs)	Well ID	Depth to Water (feet bgs)	Depth to DNAPL (feet bgs)
July 2007 Measurement Event					
LTW-1	ND	13.99	LTW-2	14.89	ND
LTW-3	ND	14.81	LTW-4	14.50	ND
LTW-5	ND	13.40	LTW-6	13.43	ND
LTW-7	ND	13.40	LTW-8	14.30	ND
LTW-9	ND	14.25	LTW-10	14.16	ND
LTW-11	ND	12.87	LTW-12	14.31	ND
LTW-13	ND	10.80	LTW-14	10.76	ND
LTW-15	ND	13.37	LTW-16	13.40	ND
LTW-17	ND	9.90	LTW-18	9.86	ND
August 2007 Measurement Event					
LTW-1	ND	14.55	LTW-2	15.48	ND
LTW-3	ND	15.56	LTW-4	15.20	ND
LTW-5	ND	14.08	LTW-6	14.57	ND
LTW-7	ND	13.96	LTW-8	16.02	ND
LTW-9	ND	14.84	LTW-10	14.85	ND
LTW-11	ND	13.42	LTW-12	15.19	ND
LTW-13	ND	11.64	LTW-14	11.61	ND
LTW-15	ND	14.57	LTW-16	14.35	ND
LTW-17	ND	11.04	LTW-18	10.90	ND
October 2007 Measurement Event					
LTW-1	ND	14.81	LTW-2	15.75	ND
LTW-3	ND	15.79	LTW-4	15.45	ND
LTW-5	ND	14.29	LTW-6	14.31	ND
LTW-7	ND	14.33	LTW-8	15.35	ND
LTW-9	ND	15.16	LTW-10	15.11	ND
LTW-11	ND	13.62	LTW-12	15.54	ND
LTW-13	ND	12.80	LTW-14	11.86	ND
LTW-15	ND	14.83	LTW-16	14.65	ND
LTW-17	ND	11.30	LTW-18	11.17	ND

ND – not detected

2.4.1 Main-Plant Area

The DNAPL investigation was completed with no DNAPL detected in any of the temporary or permanent monitoring wells in the Main-Plant Area. The following recommendations are made based on these findings.

1. Because sufficient time has elapsed to allow DNAPL to equilibrate within the 31 PTWs and none has been detected, these wells should be abandoned according to Mississippi requirements.

2. DNAPL monitoring in permanent monitoring wells MW-25, MW-27, MW-28, MW-29, and MW-30 should continue on a biennial basis for four additional years (i.e., two more monitoring events). In the event that DNAPL is detected and verified, a resumption of DNAPL recovery should occur until the recoverable DNAPL is removed.

2.4.2 Sludge-Lagoon Area

The NAPL investigation in the Sludge-Lagoon Area also has been completed, with no detections of either LNAPL or DNAPL in any of the LTW's. As such, it is recommended that the lagoon closure work plan be prepared to include: 1) in-place stabilization of the sludge based on the data and recommendations made in Section 4 of this report and 2) the design and construction of a cap system based on those data and the vadose zone contamination delineation results described in Section 3 of this report. The LTW's also should be abandoned according to Mississippi requirements at this time.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

3. VADOSE-ZONE CONTAMINATION DELINEATION IN THE SLUDGE-LAGOON AREA

3.1 Background

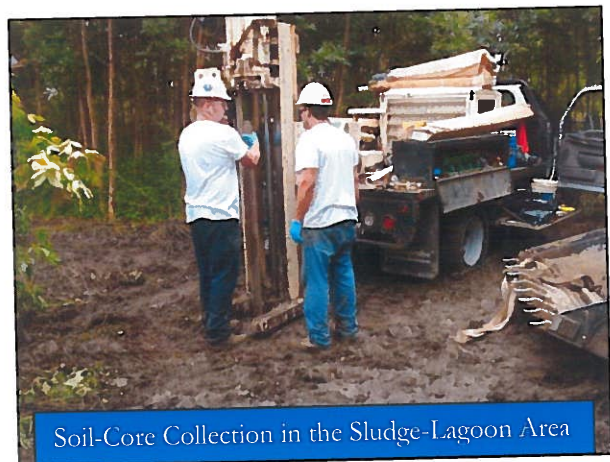
As previously described in Section 2, the Sludge Lagoon served as a retention basin for solids and chemical precipitation from the wastewater treatment plant, but is no longer active; and the closure and monitoring requirements are being addressed as part of the CMS.

In 1982, Rockwell International submitted a petition to the USEPA and MDEQ to delist this wastewater treatment sludge that had accumulated in the lagoon. In a letter dated December 22, 1982, MDEQ granted the delisting, classifying the sludge as a non-hazardous waste.

Historical observation of NAPL in MW-2, and elevated PCE, TCE and VC concentrations measured in groundwater samples from wells in the vicinity of the Sludge Lagoon Area, suggested the need for additional delineation in the vadose zone. Such delineation was deemed essential for effectively designing the post-closure cap and to ensure that transport of vadose-zone contamination does not impact groundwater in the future. The Corrective Measures Pre-Design Activities Work Plan specified the collection of vadose-zone soil cores from around the perimeter of the Sludge Lagoon. Soil cores were to be collected from the perimeter of the lagoon at depths up to 15 feet bgs. Data collected were to delineate the extent of vadose-zone contamination and define the area for placement of the soil layer/cap. VOC, SVOC, and metals analyses were to be performed if necessary to delineate the area of vadose zone impact.

3.2 Approach

Soil-core samples were collected from 12 locations around the eastern and northern sides of the Sludge Lagoon (Figure 3-1). The soil borings were advanced on approximately 60-foot spacing, with each bore hole continuously cored from ground surface to the water table using a Geoprobe® rig and a Macro-Core® sampler lined with plastic sleeves. Upon retrieval of each core segment, the plastic sleeve was removed from the sampler and then split lengthwise to expose the collected soil. The soil was inspected for visual signs of contamination, classified according to soil type, and then screened with a MiniRAE™ Model 2000 PID for total VOCs. A representative portion of the soil core showing an elevated PID response was placed into a one-quart Ziplock™ plastic bag and allowed to equilibrate for headspace analysis using the PID. Summary information for the 12 borings is provided in Appendix B.



Soil-Core Collection in the Sludge-Lagoon Area

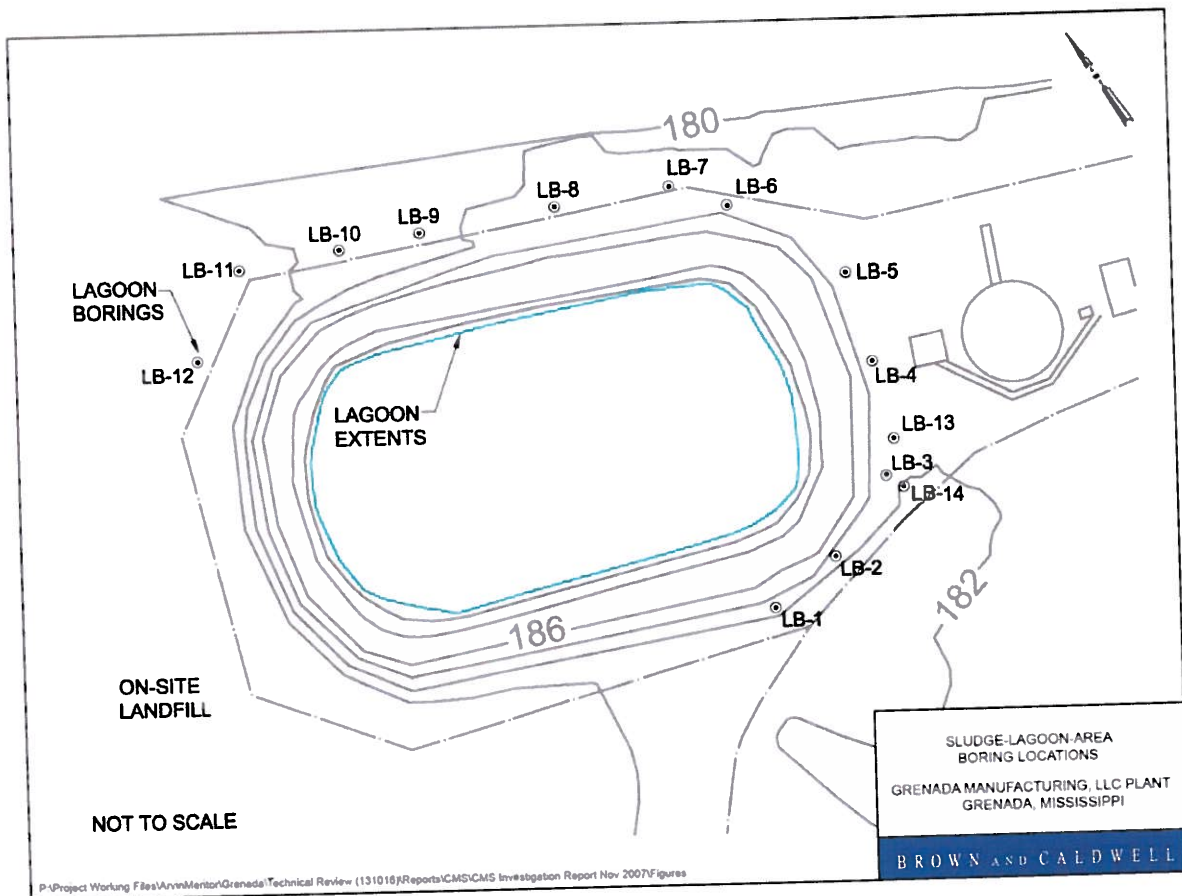


Figure 3-1. Sludge-Lagoon Area Borings

3.3 Results

Contamination was detected in soils from one of the twelve locations identified as Lagoon Boring (LB)-3 located on the south east side of the lagoon (Table 3-1). A solvent odor was noted from the shallowest core at LB-3, and elevated headspace PID measurements were recorded in the cores retrieved from 4 to 12 feet bgs from that same location. To delineate the extent of contamination in this area, two additional “step-out” borings were advanced in the immediate vicinity of LB-3. Boring LB-13 was advanced approximately 20 feet to the northeast, and boring LB-14 was advanced approximately 15 feet to the southeast, of LB-3. Neither of these step-out borings showed evidence of contamination. Boring LB-12 also had a distinct organic odor and measured an elevated headspace PID reading of 406 parts per million (ppm). However, because LB-12 was located off the northwest corner of the Sludge Lagoon in an area where soil excavation and replacement had previously been completed as part of the former landfill remediation project, no additional step-out borings were completed in that area.

3.4 Recommendations

The results from the soil borings achieved the objective of delineating the extent of vadose-zone contamination associated with the lagoon. For the majority of the lagoon perimeter, the contamination is confined within the lagoon berm. The exceptions were at LB-3 located toward the southeastern edge of the

Table 3-1. Vadose-Zone Soil-Boring Data and Observations

Location	Date	Depth (ft)	PID (ppm)	DTW (ft)	Associated Shallow Well	Notes
LB-1	7/14/2007	0-4	3.0	12.0	LTW-11	No physical evidence of contamination.
		4-8	16.0			
		8-12	16.5			
		12-16	0.5			
LB-2	7/14/2007	0-4	8.0	11.0	NA	No physical evidence of contamination.
		4-8	22.5			
		8-12	2.9			
		12-16	2.9			
LB-3	7/12/2007	0-4	11.0	11.0	LTW-9	Solvent odor in 4-8' bagged sample.
		4-8	500.0			
		8-12	150.0			
		12-16	8.8			
LB-4	7/13/2007	0-4	0.0	12.0	NA	No physical evidence of contamination.
		4-8	0.0			
		8-12	0.0			
		12-16	0.8			
LB-5	7/13/2007	0-4	0.0	11.0	LTW-7	No physical evidence of contamination.
		4-8	2.7			
		8-12	0.4			
LB-6	7/13/2007	0-4	0.3	13.0	NA	No physical evidence of contamination.
		4-8	0.0			
		8-12	0.2			
		12-16	0.2			
LB-7	7/11/2007	0-4	0.0	12.0	LTW-1	No physical evidence of contamination.
		4-8	0.1			
		8-12	0.1			
		12-16	0.6			
LB-8	7/11/2007	0-4	0.6	12.5	NA	No physical evidence of contamination.
		4-8	2.5			
		8-12	1.8			
		12-16	1.0			
LB-9	7/12/2007	0-4	0.0	12.0	LTW-3	No physical evidence of contamination.
		4-8	0.0			
		8-12	0.0			
		12-16	0.0			
LB-10	7/12/2007	0-4	0.0	10.5	NA	No physical evidence of contamination.
		4-8	0.0			
		8-12	0.0			
LB-11	7/11/2007	0-4	0.1	11.0	LTW-5	No physical evidence of contamination.

Location	Date	Depth (ft)	PID (ppm)	DTW (ft)	Associated Shallow Well	Notes
		4-8	0.3			
		8-12	36.2			
		12-16	64.0			
		16-20	10.0			
		20-24	8.5			
LB-12	7/14/2007	0-4	9.5	11.0	NA	No physical evidence of contamination.
		4-8	279.0			
		8-12	406.0			
		12-16	80.0			
LB-13	7/16/2007	0-4	1.4	11.0	NA	No physical evidence of contamination. Step out boring from LB-3.
		4-8	24.1			
		8-12	25.3			
LB-14	7/16/2007	0-4	0.0	11.0	NA	PID of 15 ppm at 8-12' sample core. Step out boring from LB-3.
		4-8	2.5			
		8-12	6.5			

lagoon, and LB-12 located adjacent to the lagoon's northwest corner. At LB-3, the contamination was delineated to be within the boundaries defined by LB-13 and LB-14, and at LB-12 soil remediation had previously been completed just to the west of that boring location. The following recommendations are made based on the above delineation and the results from the NAPL investigation discussed in Section 2 that found no LNAPL or DNAPL in the Sludge-Lagoon Area.

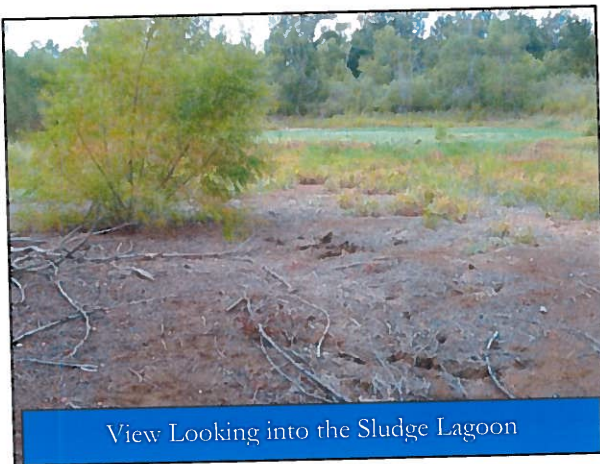
1. Based on the limited amount of contamination found in the vadose zone and the lack of NAPL detections in the Sludge-Lagoon Area, it is recommended that the lagoon move to closure with in-situ stabilization of the sludge remaining in the lagoon, and placement of a cover/cap to minimize infiltration through the stabilized sludge. The placement of the PRB has ensured that any chlorinated solvents, daughter products, or reducible metals emanating from, or migrating under, the sludge lagoon will be intercepted and treated before the groundwater feeds to Riverdale Creek.
2. A Sludge-Lagoon Closure Plan should be prepared to specify the stabilization procedure and include the design of a soil cover/cap that encompasses the lagoon proper and the perimeter areas as shown by the dotted line in Figure 3-2. The stabilization agents and selection of a blend composition and ratio are discussed in Section 4.
3. The closure and post-closure costs are included in the current Financial Assurance Plan (see Appendix D). Because the Sludge Lagoon will be closed with the sludge left in place, the post closure costs will be updated based on the needs for post closure maintenance and monitoring, and those costs will be included in the Financial Assurance Plan accordingly.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

4. SLUDGE SOLIDIFICATION/STABILIZATION TREATABILITY STUDY

4.1 Background

The Sludge Lagoon (SWMU4) served as a retention basin for solids and chemical precipitates from the wastewater treatment plant. The lagoon was put into operation in 1977. In 1982, Rockwell International submitted a petition to USEPA and MDEQ to request delisting of the sludge that had accumulated in the lagoon. MDEQ granted the delisting in a letter dated December 22, 1982, and the sludge is not a hazardous waste. The lagoon is no longer active and per the requirements of the HSWA permit issued July 31, 1998, and the findings from the CMS, the lagoon is to be closed by stabilizing the sludge in place and covering or capping the remaining impacted soils. The objective of stabilization is to improve the compressive strength of the sludge to allow placement of a cap/cover that will minimize infiltration of precipitation and/or surface water runoff through the former lagoon area.



View Looking into the Sludge Lagoon

The Corrective Measures Pre-Design Activities Work Plan specified the collection of up to three sludge samples for bench-scale stabilization/solidification evaluation. This evaluation was to include combinations of the sludge and up to three solidification/stabilization agents (Type I Portland cement (PC), cement kiln dust (CKD), lime kiln dust (LKD), and/or hydrated lime (HL)) with the objective of determining the optimal combination for increasing the compressive strength of the sludge so that it could support the placement of soils and cap materials without undergoing deformation, which could cause excessive settling of the cover material and cap. An added benefit of using the aforementioned solidification agents is

their ability to bind and stabilize many types of contaminants. The data from the bench-scale tests will be used to formulate the lagoon closure plan, which is to include the stabilization/solidification formulation and the design of the capping/cover system.

4.2 Approach

Evaluating the solidification/stabilization of the sludge remaining in the lagoon entailed collecting discrete samples, characterizing the physical/chemical properties of those samples, and then subjecting the samples to a variety of treatments and analyses. The methods used for sampling, testing, and analyses are described in the following sections.

4.2.1 Sludge Sampling

In August 2007, sludge samples were collected from the three locations within the Sludge Lagoon as shown in Figure 4-1. The samples were identified as L-1 NE for the sample collected from the northeast corner of

the lagoon, L-2 NW for the sample collected from the northwest corner, and L-3 SE for the sample collected from the southeast corner of the lagoon. The samples were collected with a hand shovel by first removing the soil layer covering the sediment and then digging out the sediment and transferring it to 5-gallon plastic buckets. Two buckets were collected at each location with each bucket collected from a dedicated hole, resulting in a total volume of 10 gallons of sample per location. The buckets were labeled and sent under chain-of-custody procedures to KEMRON Environmental Services' laboratories in Atlanta, Georgia for physical/chemical properties analyses and bench-scale stabilization testing as described below. The final technical report from KEMRON Environmental Services provides detailed descriptions of the sample processing, experimental testing, and analytical methodologies along with a comprehensive discussion of the results. A copy of the report is in Appendix C.

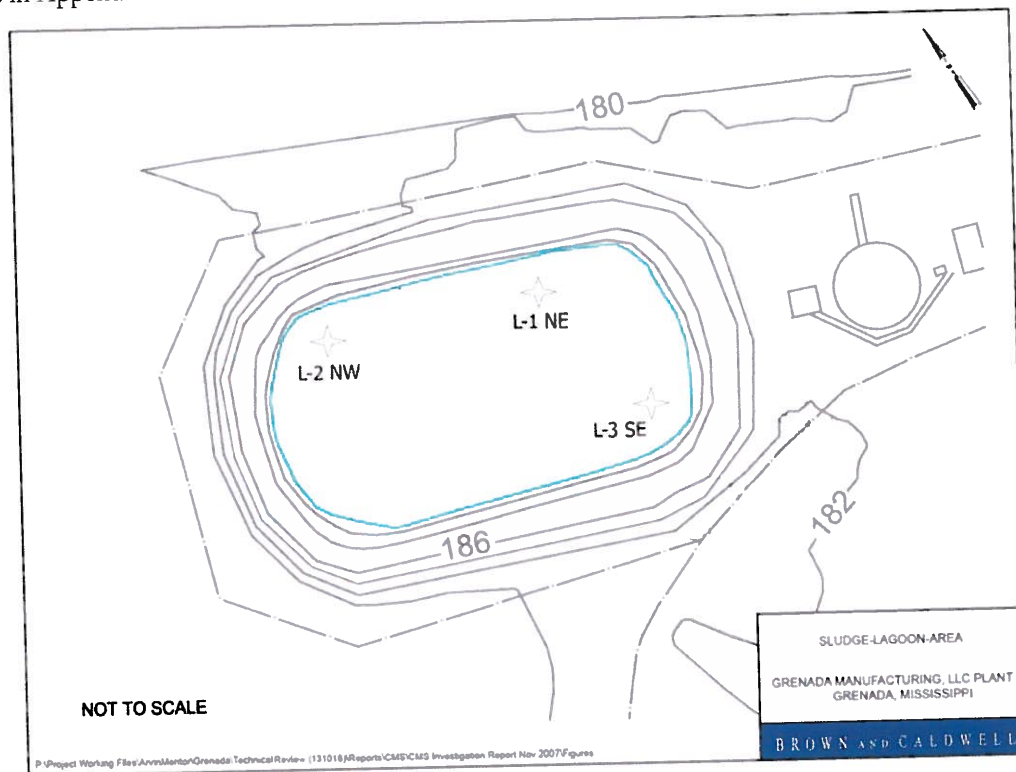


Figure 4-1. Sampling Locations for the Bench-Scale Sludge-Treatability Studies

4.2.2 Sludge Properties Analyses

Prior to subjecting the sludge samples to the various treatments, the pH, bulk density (unit weight), specific gravity, moisture content, percent solids, particle size distribution, and one-dimensional consolidation were

measured on the raw sludge using the respective methods listed in Table 4-1. The void ratio or porosity was calculated based on the results from the sludge properties analyses.

Table 4-1. Test Procedures

Parameter	Method	Parameter	Method
pH	EPA 9045	Percent Solids	EPA
Bulk Density	ASTM D2937	Solid Specific Gravity	ASTM D854
Moisture Content	ASTM D2216	Particle Size Distribution	ASTM D422
One-Dimensional Consolidation	ASTM D2435	Void Ratio/Porosity	Calculated

4.2.3 Sludge-Stabilization Testing

Stabilization trials involved mixing pre-weighed portions of the sludge with measured aliquots of Type I PC and either HL, LKD, or CKD in the percentages that are shown in Table 4-2. The percentages of the reagents were based on the weight of the amount of untreated sludge tested. Once the test samples were prepared, they were placed into plastic cylindrical curing molds and placed into a humid environment to cure. After a 14-day curing period, the samples were subjected to Unconfined Compressive Strength (UCS) testing according to ASTM D2166, and the volumetric expansion was determined.

Table 4-2. Experimental Conditions

Reagent Mixture	Sludge Sample					
	L-1 NE		L-2 NW		L-3 SE	
	Reagent Addition(%)	Water Addition(%)	Reagent Addition(%)	Water Addition(%)	Reagent Addition(%)	Water Addition(%)
Type I PC/Hydrated Lime	7.5/10	0	7.5/10	0	7.5/10	0
Type I PC/Hydrated Lime	10/12.5	0	10/12.5	0	10/12.5	0
Type I PC/Hydrated Lime	15/10	15.0	15/10	16.7	15/10	16.3
Type I PC/LKD	7.5/20	0	7.5/20	0	7.5/20	0
Type I PC/LKD	10/20	0	10/20	0	10/20	0
Type I PC/LKD	15/30	15.8	15/30	15.3	15/30	17.6
Type I PC/CKD	7.5/20	0	7.5/20	0	7.5/20	0
Type I PC/CKD	10/20	0	10/20	0	10/20	0
Type I PC/CKD	15/30	18.3	15/30	21.9	15/30	21.0

The volumetric expansion was measured under each of the experimental conditions after 14 days to assess the changes that could be expected during full-scale implementation. The test included partially filling 2-inch diameter by 4-inch long molds with the treated sludges, and then immediately recording the heights of the material in the molds. Following the 14-day cure time, the height was again measured and the volumetric expansion (or shrinkage) was calculated as follows:

$$\text{Volumetric Expansion (\%)} = \frac{\text{Final Height} - \text{Initial Height}}{\text{Initial Height}} \times 100$$

After 28 days of curing, samples were selected for one-dimensional consolidation testing following American Society for Testing and Materials (ASTM) D2435. Six samples treated with mixtures of Type I PC at either 7.5% or 10% in combination with 20% lime kiln dust, and two samples of each untreated material, were tested. The maximum standard loading schedule used was 4 tons per square foot (TSF).

4.3 Results

Results from the tests conducted on the sludge samples were received on November 14, 2007 and are summarized in the following sections. More details on the test results can be found in KEMRON's final report in Appendix C.

4.3.1 Sludge Properties Analyses

The results of the properties analyses of the three sludge samples are shown in Table 4-3. The pH values of the three sludge samples were similar and in the near neutral range. The bulk densities also were similar among the three sludge samples. The remaining parameters measured similarly in between samples L-1 NE and L-3 SE, with slight differences in the percentages of silt and clay. Sample L-2 NW differed from these two samples, having a higher moisture content, lower percent solids, higher specific gravity, lower silt and higher clay content, and higher porosity. The higher moisture content of L-2 NW suggested that it would represent the "worst case scenario" from a stabilization perspective, so that sample was selected for the preliminary stabilization evaluations. Once those preliminary evaluations were complete, the stabilization tests were performed on all remaining samples.

Table 4-3. Physical Characterization of Lagoon Sludge Samples

Testing Parameter	Unit	Sample L-1 NE	Sample L-2 NW	Sample L-3 SE
pH	s.u.	6.07	6.14	6.27
Bulk Density	lb/ft ³	69.0	68.6	68.8
Moisture Content	%	318.73	463.98	335.73
Percent Solids	%	23.88	17.73	22.95
Specific Gravity	--	1.84	2.14	1.86
Particle Size	% Gravel	0.0	0.0	0.0
	% Sand	1.5	1.2	1.4
	% Silt	87.4	75.8	84.2
	% Clay	11.1	23.0	14.4
Porosity	%	85.6	90.9	86.4

4.3.2 Sludge Stabilization Testing

Table 4-4 contains the time series of penetrometer measurements and the UCS results from the analyses on Day 14 for nine experimental conditions for each of the three sludge samples. The penetrometer data indicate that materials treated with Type-1 PC and LKD exhibited the greatest strength increase at the 14-day cure interval. The UCS data indicate that addition of water to the sludge did not result in large increases in the strength of the stabilized material. The poor strength performance observed in sample L-2 NW could be attributed to the higher liquid content, which would suggest that dewatering may be required in stabilizing the sludge in this section of the lagoon.

Table 4-4. Penetrometer and UCS Measurements Made 14 Days after Treatment

Sample	Reagent	Reagent Addition (%)	Water Addition (%)	Penetrometer Results (tons/ft ²)								UCS (psi)	
				Days Following Treatment									
				1	3	4	5	6	7	8	14		
L-1 NE	Type I PC/HL	7.5 / 10	0	0	--	--	--	0.25	0.5	0.5	1	15.0	
		10 / 12.5	0	0	--	--	--	0.25	0.75	1	1.5	21.7	
		15 / 10	15.0	0	--	--	--	0	0.5	0.5	1.75	24.1	
		15 / 30	15.8	0	--	--	--	2	2.25	2.75	3.25	27.1	
	Type I PC/LKD	7.5 / 20	0	0	--	--	--	1.25	1.5	2	2.2	37.3	
		10 / 20	0	0	--	--	--	1.5	1.75	2	2.8	42.5	
		15 / 30	15.8	0	--	--	--	2	2.25	2.75	3.25	NA	
	Type I PC/CKD	7.5 / 20	0	--	--	0	--	0	0	0	0	NA	
		10 / 20	0	--	--	1.25	--	1.25	1.25	1.25	1.35	17.3	
		15 / 30	18.3	--	--	1	--	1.5	1.5	1.85	2	26.4	
L-2 NW	Type I PC/HL	7.5 / 10	0	--	--	0	--	0	0	0	0	NA	
		10 / 12.5	0	--	--	0	--	0	0	0	0.25	7.5	
		15 / 10	16.7	--	--	0	--	0	0	0	0.25	8.2	
		15 / 30	16.7	--	--	0	--	0	0.25	0.25	0.6	10.2	
	Type I PC/LKD	7.5 / 20	0	--	--	0	--	0	0.25	0.75	1	1.75	16.4
		10 / 20	0	--	--	0.5	--	0.75	0.75	1	1.75	19.8	
		15 / 30	15.3	--	--	0	--	0.5	1	1	1.75	NA	
	Type I PC/CKD	7.5 / 20	0	--	--	0	--	0	0	0	0	NA	
		10 / 20	0	--	--	0	--	0	0	0.25	0.6	10.6	
		15 / 30	21.9	--	--	0	--	0.25	0.5	0.5	1	14.5	
L-3 SE	Type I PC/HL	7.5 / 10	0	--	--	0	--	0	0	0	0	NA	
		10 / 12.5	0	--	--	0	--	0	0.25	0.6	1	24.2	
		15 / 10	16.3	--	--	0	--	0	0	0	1	15.1	
		15 / 30	16.3	--	--	0	--	0	0	0	1	15.1	
	Type I PC/LKD	7.5 / 20	0	--	0.25	--	1	1.25	1.5	--	2.15	27.4	
		10 / 20	0	--	1	--	1.75	2	2	--	3.25	39.3	
		15 / 30	17.6	--	1	--	1.25	1.75	2.5	--	4.25	45.1	
	Type I PC/CKD	7.5 / 20	0	--	0.0	--	0.0	0.0	0.0	--	0.0	NA	
		10 / 20	0	--	0.0	--	0.0	0.0	0.0	--	0.0	7.2	
		15 / 30	21.0	--	0.75	--	1.5	1.65	2.25	--	2.75	27.0	

NA - the sample was unable to withstand its own weight

-- Not measured

Results of the test show that at 0.5 TSF, the strains on the untreated sludges were approximately 32%, 50%, and 34% for sludge samples L-1 NE, L-2 NW, and L-3 SE, respectively. The Type I PC to lime kiln dust ratio of 7.5:10 reduced the strains at 0.5 TSF to approximately 2.4%, 4.0%, and 1.7% for sludge samples L-1 NE, L-2 NW, and L-3 SE, respectively. The strains on sludge samples L-1 NE and L-2 NW were further reduced at the amendment ratio of 7.5:20, measuring strain values of 1.3% and 3%, respectively. Sludge sample L-3 SE showed a slightly increased strain value of 4.0 at the higher lime kiln dust addition.

The resulting moisture contents, bulk densities, dry densities, and volumetric expansions as a function of the different reagent/water treatments for the three lagoon-sludge samples at the end of the 14-day UCS test are

listed in Table 4-5. The volumetric expansions measured 14 days after treatment ranged from -5.45% to 27.15% across all of the mix designs and the three samples. The volumetric expansions observed after treatment of sample L-1 NE ranged from -5.45% to 27.15%, exhibiting the widest range in the determination for all mix designs. For L-2 NW, the volumetric expansions ranged from 10.18% to 25.24%; and for L-3 SE the range was 8.01% to 26.95%. Within each reagent combination, the volumetric expansion increased with increased reagent addition. The largest difference in the volumetric expansion across any one reagent type was 20.5% when sample L-1 NE was treated with the combination of Type I Portland Cement and Hydrated Lime. The smallest range in volumetric expansion among all of the test conditions was 5.28%, which occurred when sample L-2 NW was amended with Type I PC and Hydrated Lime.

Table 4-5. Physical Properties of the Three Sludge Samples 14 Days after Reagent and Water Addition

Sample	Reagent	Reagent Addition (%)	Water Addition (%)	Moisture Content (%)	Bulk Density (lbs/ft ³)	Dry Density (lbs/ft ³)	Vol. Expan. %
L-1 NE	Type I PC/HL	7.5 / 10	0	151.66	76.4	30.4	-5.45
		10 / 12.5	0	144.2	77.3	31.6	8.59
		15 / 10	15.0	158.54	76	29.4	15.04
	Type I PC/LKD	7.5 / 20	0	128.34	80.4	35.2	10.94
		10 / 20	0	118.38	81.1	37.2	13.28
		15 / 30	15.8	109.42	83.2	39.7	21.09
	Type I PC/CKD	7.5 / 20	0	NA	NA	NA	10.51
		10 / 20	0	127.14	81.1	35.7	11.52
		15 / 30	18.3	128.3	81.8	35.8	27.15
L-2 NW	Type I PC/HL	7.5 / 10	0	NA	NA	NA	10.18
		10 / 12.5	0	180.2	77.1	27.5	15.07
		15 / 10	16.7	197.55	76.3	25.6	15.46
	Type I PC/LKD	7.5 / 20	0	153	80.4	31.8	15.46
		10 / 20	0	143.58	80.6	33.1	14.09
		15 / 30	15.3	123.16	83.7	37.5	24.07
	Type I PC/CKD	7.5 / 20	0	NA	NA	NA	14.68
		10 / 20	0	153.33	79.8	31.5	18.00
		15 / 30	21.9	145.01	81.3	33.2	24.24
L-3 SE	Type I PC/HL	7.5 / 10	0	NA	NA	NA	8.01
		10 / 12.5	0	147.89	77.1	31.1	10.55
		15 / 10	16.3	165.42	76.2	28.7	17.38
	Type I PC/LKD	7.5 / 20	0	133.4	80.2	34.3	9.37
		10 / 20	0	124.6	81.5	36.3	14.26
		15 / 30	17.6	119.5	82.3	37.5	25.78
	Type I PC/CKD	7.5 / 20	0	NA	NA	NA	12.89
		10 / 20	0	138.5	80.9	33.9	14.06
		15 / 30	21.0	127.1	80.9	35.6	26.95

Note that NA means the sample was unable to withstand its own weight.

4.4 Recommendations

The following recommendations are made based on the data discussed in this report section and the experience that a UCS value between 12 and 15 psi would be sufficient to support the construction equipment needed to mix in the stabilization agents and construct the cap, as well as the weight of the soil cap itself.

1. A 7.5% Type I PC and 20% LKD reagent blend should be used for stabilizing the sludge in place.
2. Sludge in the northwest section of the lagoon should be dewatered using wick drains to decrease the moisture content by approximately 30% to ensure that the UCS of the treated material meets the 12 to 15 psi criterion. An alternative approach would be to increase the rate of additions on both the Type I PC and LKD while keeping the relative proportions of those two reagents constant.
3. An increase in volume of the treated material of up to 12% should be accounted for in calculating the amount of fill material required and for designing the cover/cap. A cure time of at least 14 days should be allowed before backfilling the lagoon.

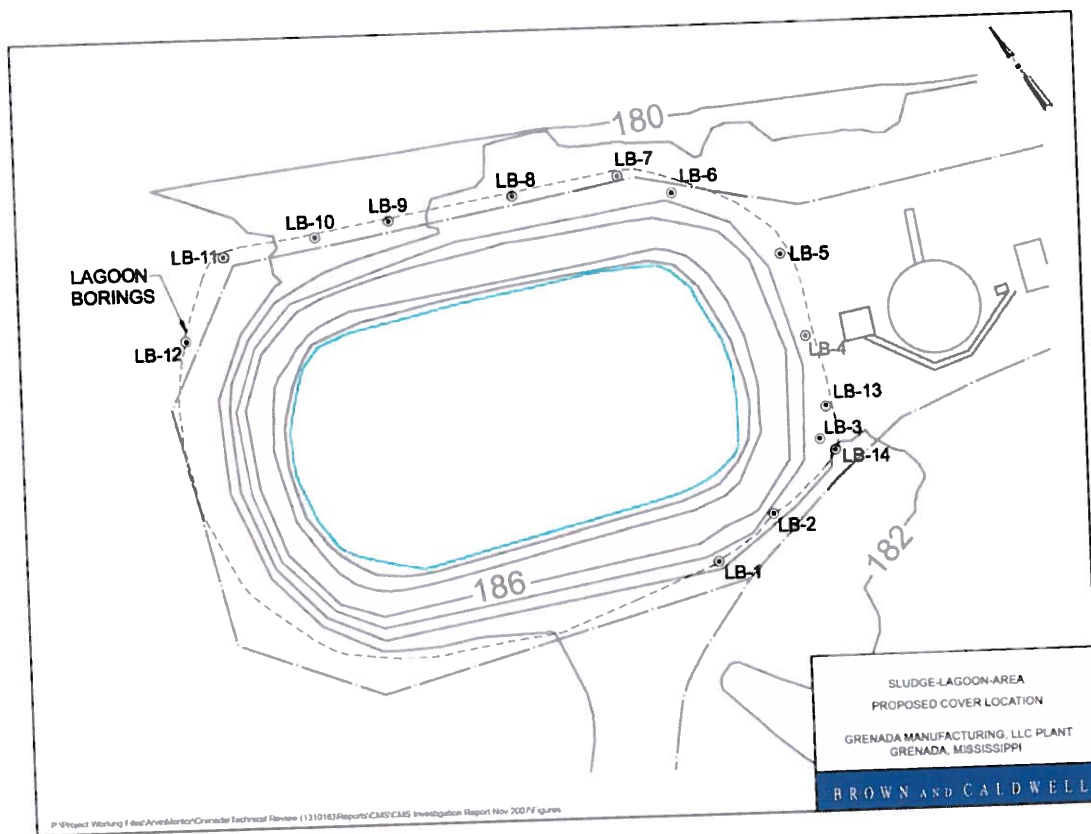


Figure 4-1: Proposed Sludge Lagoon Cap

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

5. SHEET-PILE BARRIER & GROUNDWATER MODELING

5.1 Background

The CMS proposed evaluation of the installation of a sheet-pile barrier at AOCs A and B to prevent the flow of off-site water into the contamination source zones. Although a sheet-pile barrier would not provide significant mass reduction, it could potentially retard contaminant migration downstream by diverting groundwater flow around the NAPL areas. The location of the proposed sheet-pile barrier is shown in Figure 5-1. A numerical groundwater flow model was developed for the site to evaluate the effectiveness of the proposed sheet-pile barrier near AOCs A and B.

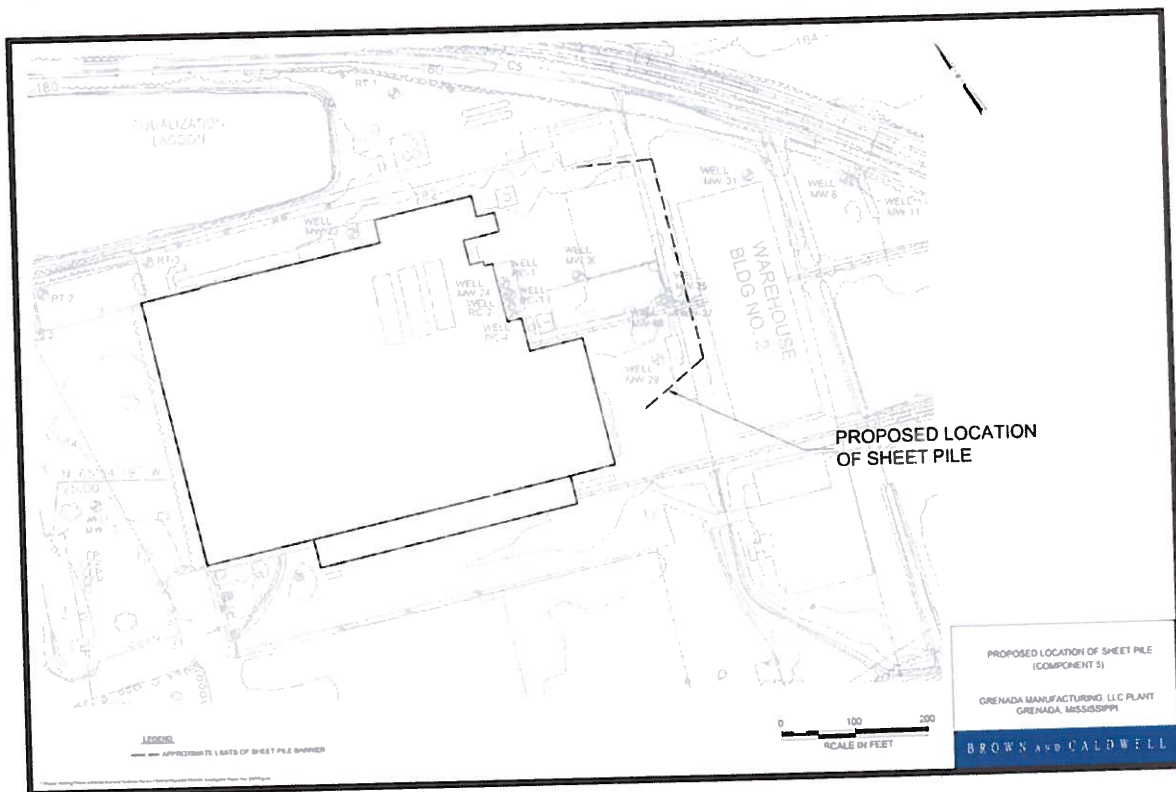


Figure 5-1. Proposed Location of the Sheet-pile barrier

5.2 Approach

The groundwater flow and transport model was developed using MODFLOW and MT3D, respectively, to estimate the transport of TCE from the source area, AOC A, to the PRB with and without the sheet-pile barrier in place. The current site conceptual hydrogeologic model and groundwater elevation data from November 2003 were used for model development and calibration.

The groundwater flow model was set up using the graduated grid system shown in Figure 5-2. The grid extended to the east, west, and south beyond the plant site and to the area's natural boundaries (i.e., Riverdale Creek and the Yalobusha River). The northern boundary was represented as a general head boundary, and the heads associated with the general head cells were derived from estimates of regional shallow aquifer groundwater elevations based on site data, creek and river stages, and surface topography. River cells were used to represent Riverdale Creek and the Yalobusha River. Heads for the river cells were based on topographic map information. The smallest grid intervals were established in the vicinity of the source and plant area where the grid cells had dimensions of 5 ft by 5 ft. The remainder of the grid cells increased by a factor of 1.5 and extended to the outer limits of the model.

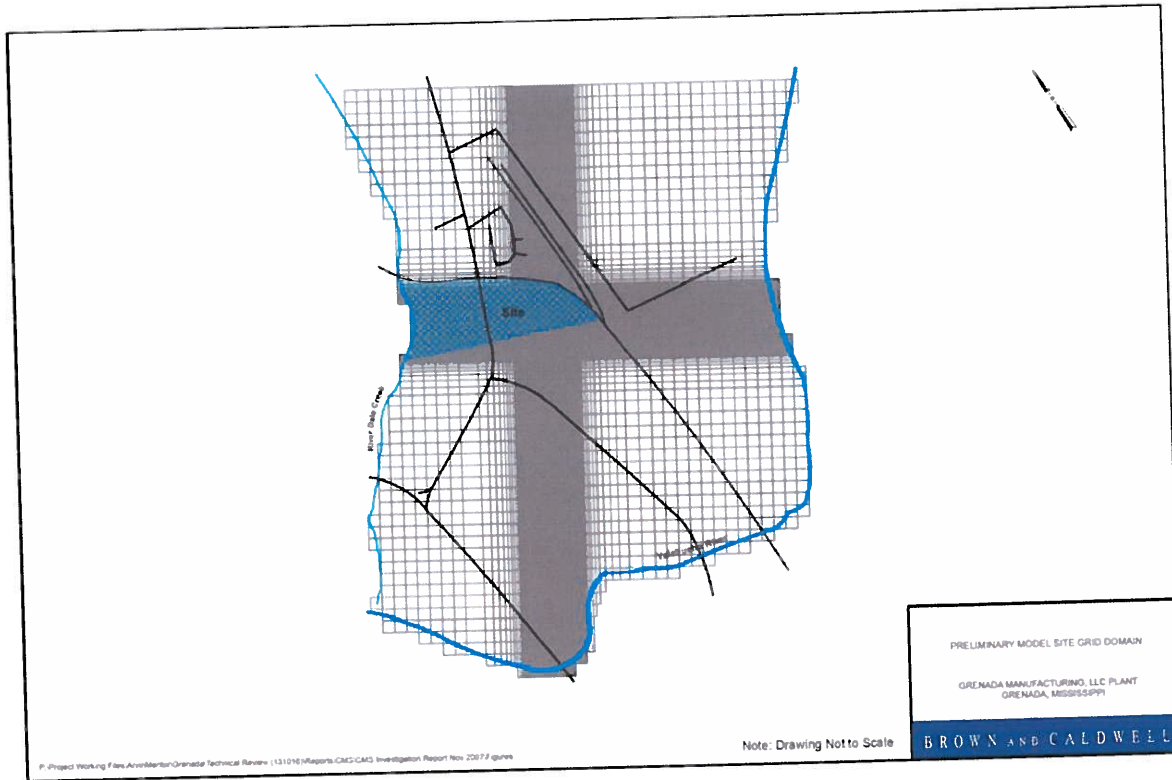


Figure 5-2. Grid Construction for Groundwater Flow Modeling

The groundwater flow model consisted of four layers to represent the upper aquifer. Layer 1 represented the upper clayey silt zone, and varied in thickness due to ground surface elevation changes. This layer was assigned a K value of 0.34 ft/day. Layers 2, 3, and 4 represented the sand unit. Each layer was set at 12 feet thick, and assigned a K value of 43 ft/day. The on-site portion of the model had an average total thickness of 45 ft and the vertical K values were assumed to be 10% of the individual horizontal K values.

The sheet pile was modeled to extend 60 feet below ground surface and be keyed into the marl aquitard. Model boundaries extend to Riverdale Creek and the Yalobusha River. When use of natural boundaries was not feasible, the limits were extended to avoid artificially influencing the simulations. Areal recharge was assumed to be 14 inches per year, effective porosity was 0.3, and soil density was 1.8 g/cm³. The fraction of organic carbon in the soil, f_{oc} , was set to 0.001. Longitudinal, transverse, and vertical dispersions were 10, 1, and 0.1, respectively.

The intent of groundwater flow model was to reasonably represent site conditions to evaluate the time-dependent impact that placing a sheet-pile wall adjacent to the source area would have on the plume dynamics. As such, rigorous calibration was not necessary and was not performed; however, a sensitivity analysis was performed. The model parameters that were varied included the K values and areal recharge, which were varied over reasonable ranges to develop a groundwater flow field that reasonably represented site conditions for both groundwater elevation and gradient.

The transport model was set up using a sub-grid of the flow model (Figure 5-3) to increase the calculation efficiency. TCE was modeled using an effective porosity of 0.3, a longitudinal dispersion of 10, a transverse dispersion of 1.0, a vertical dispersion of 0.1, $f_{oc} = 0.001$, a soil density of 1.8 g/cm^3 , and a $\text{Log } K_{oc}$ of 2.5. The transport model was designed with a constant mass flux of $1,000 \text{ mg/L}$ for 30 years, after which a 5-year half life was applied for an additional 70 years.

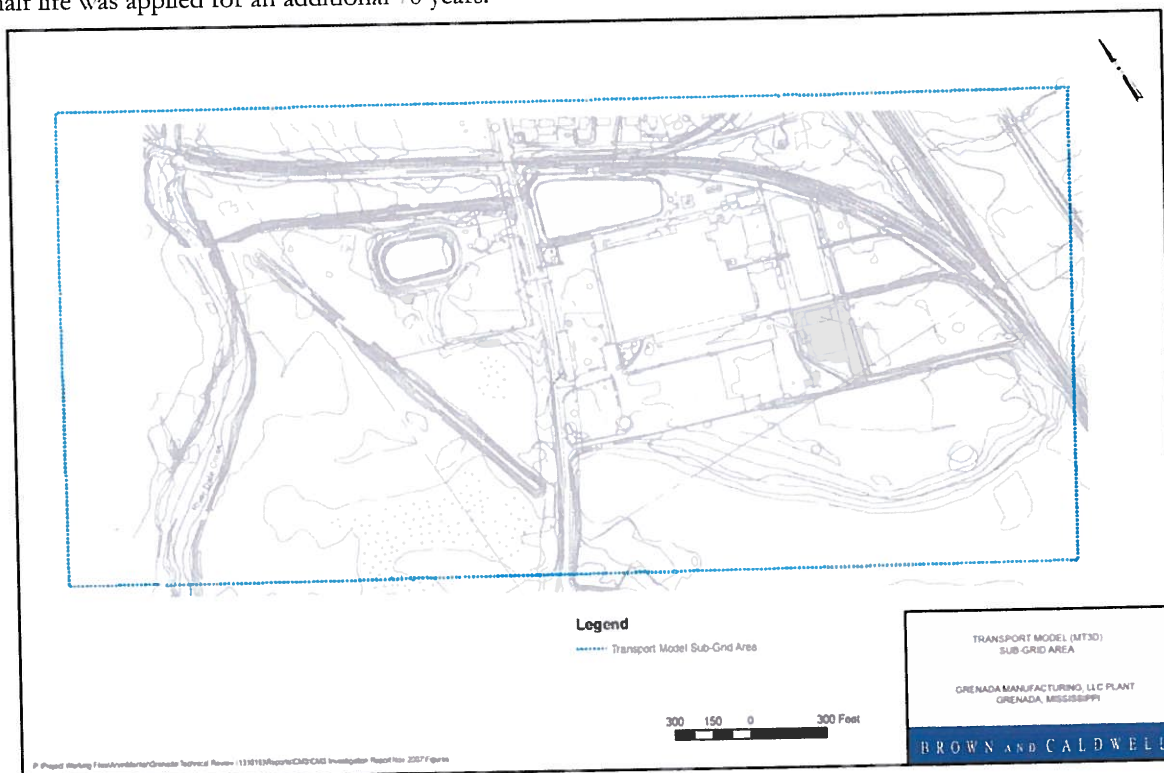


Figure 5-3. Sub-grid Area used for Transport Modeling

The source area was represented as a constant source of $1,000 \text{ mg/L}$, which was applied to cells in Layer 2, for an initial period of 30 years. Following the initial 30-year period, a half-life of 5 years was applied to the mass flux, and the model was run for an additional 70 years to represent the flux of TCE from the source area as the source mass declines. The total mass flux of TCE through the location of the PRB was then estimated for the two scenarios, with and without the sheet-pile barrier. This 100-year simulation was then run to quantify any benefits of the proposed sheet-pile barrier. The first simulation was run to determine the mass flux of TCE through the PRB without the sheet-pile barrier.

5.3 Results

The groundwater flow model calibrated using field water-level measurements from November 2003 produced the contour map shown in Figure 5-4. The resulting contours were in close agreement with contours developed from actual water-level data at the site obtained over many years of site monitoring.

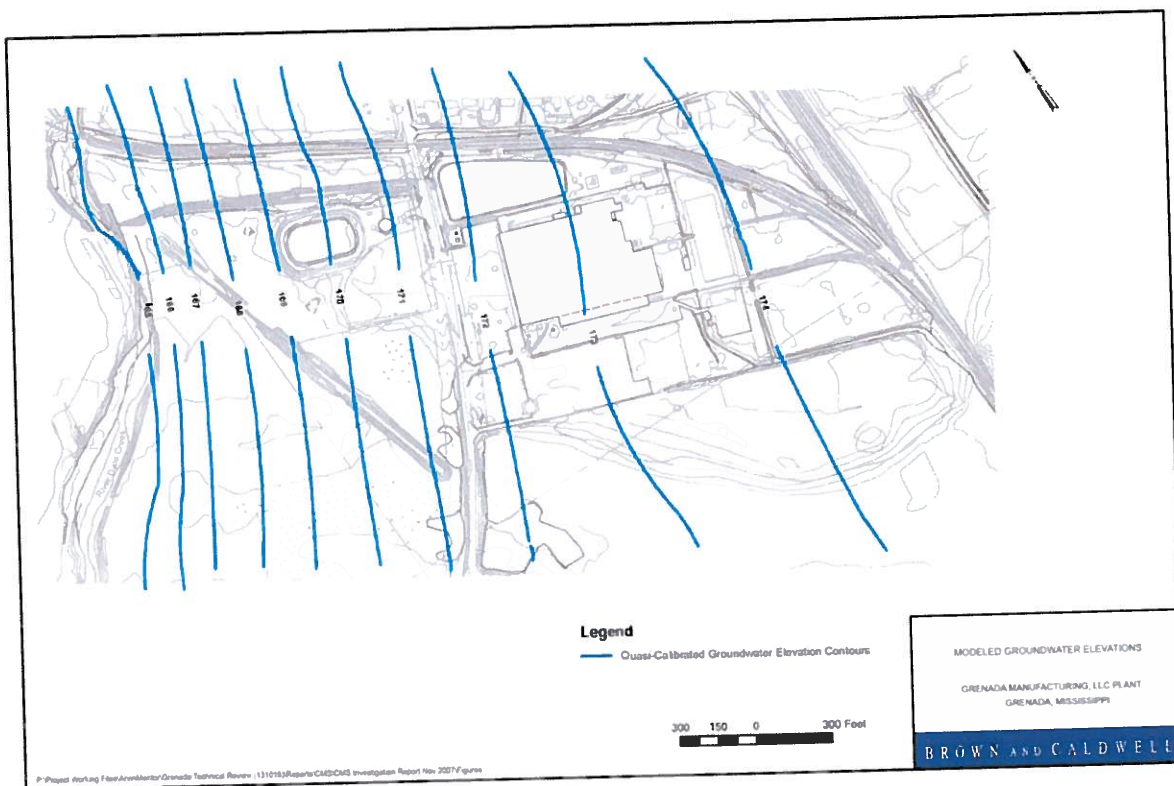


Figure 5-4. Calibrated Model Groundwater Elevations based on Monitoring Well Data from November 2003

The model run with the sheet-pile barrier in place produced the groundwater elevation contours shown in Figure 5-5. The contours show the effect that the wall would have in disrupting the flow field in the source area. Although flow is diverted around the barrier, the model output indicates that flow would continue to contact the source, albeit at a somewhat reduced rate of flux. The impact on the flow field appears relatively short lived, with the water-elevation contours returning to pre-barrier conditions within approximately 100 to 150 feet down gradient, indicating that the overall groundwater flux at the Site would not be impacted by the placement of the sheet-pile barrier.

The transport model was calibrated using TCE data from the site. The calibrated model was run to simulate a 30-year period, resulting in the plume configuration shown in Figure 5-6. This period was similar to the time that had elapsed since the TCE was likely released in the source area. The shape and general concentration profile are similar to the plume that is observed at the Site, indicating that the model provides a good approximation of the fate and transport of TCE from the source area to the location of the PRB. This indicated that the model was appropriately calibrated for making the with-and-without sheet-pile barrier comparisons.

The first transport simulation that was run to determine the mass flux of TCE through the PRB without the sheet-pile barrier showed that 1.243×10^9 mg of TCE would pass through the PRB during the 100-year simulation. The second simulation that was run with a sheet-pile barrier placed as shown in Figure 5-1 resulted in a total TCE-mass flux through the PRB of 1.202×10^9 mg during the 100-year simulation.

The difference between simulations suggested that a 3% decrease in flux might be realized if the sheet pile barrier was installed. This level of difference in contaminant mass flux between the two simulations was within the potential range of error in the model and not considered to be significant.

5.4 Recommendations

The results from the two modeling exercises show a minimal impact on the TCE plume dynamics over time. The localized changes in the flow field would not be sufficient to significantly reduce the flux of contaminant from the source area. In fact, installing a sheet-pile barrier in the source area could prove detrimental to attaining the groundwater cleanup objectives. Reducing the flux rate by as little as 3%, would slow down the transport of TCE from the source area to the PRB where contaminant destruction is occurring. The net result would be an increase in the time that the PRB must remain online, which in turn would require additional cleaning/rejuvenating cycles due to the fact that the groundwater flux through the PRB is unimpeded, and also would most likely extend the time required for the monitoring program to remain in place. It is possible that the extended time could exceed the useful life of the PRB and that an additional treatment technology/process would be required to prevent contaminant from reaching Riverdale Creek. Taking these things into consideration, along with the fact the PRB was designed to treat the contaminant flux without the sheet-pile barrier, results in the conclusion that it does not make sense to disrupt the groundwater flow field to achieve a slight reduction in contaminant flux.

To complete the evaluation of potential LNAPL (i.e., toluene and TCE) impacts to indoor air quality, it is recommended that the same locations from the previous monitoring events be sampled. The sampling would be conducted in a pair of temporal monitoring events to be performed during the “heating” and “cooling” periods. It is further recommended that the first monitoring event take place in August 2008 and the second event occur in February 2009. If the results from these paired events confirm that toluene and TCE are flushing from under the Main Plant Building, and there is no buildup of these contaminants in indoor air, then future indoor-air monitoring will be suspended. If the results indicate that vapor intrusion is a concern, potential mitigation options will be discussed with EPA to select the best approach for addressing that concern.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

6. HIGH-VACUUM MULTI-PHASE-EXTRACTION PILOT TEST

6.1 Background

LNAPL, primarily toluene, was detected on the east side of the Main-Plant building in the vicinity of the Former Toluene Underground Storage Tank (UST) Area (AOC B) during a site-wide groundwater quality survey. In October 1993, an automated LNAPL-recovery system was installed and operated for approximately two years. The recovery system included four wells located immediately behind the Main-Plant building (Figure 6-1). During the two year operating period, over 2,000 gallons of LNAPL were removed. The automated recovery system was removed in 1995 once product thicknesses were determined to be sufficiently minimized. Residual toluene was then manually recovered from 1995 to 2003. The data do not exist for the manual removal events between 1995 and 2000, but from August 2000 through May 2003, approximately 121 gallons of LNAPL were recovered, bringing the total volume of toluene recovered to more than 2,121 gallons.

In August 2007, a round of LNAPL measurements was made in the four extraction wells, and the results are shown in Table 6-1. Measured LNAPL was found in RC-2 and RC-4, which are the two wells closer to the former toluene storage area (Figure 6-1), and no LNAPL was found in the two extraction wells further to the north.

Table 6-1: Historical LNAPL and Water-Level Data

Date	Well ID	Depth to LNAPL (feet TOC)	Depth to Water (feet TOC)	LNAPL Thickness (feet)	LNAPL Volume in Well (gallons)
8-27-07	RC-1	NP	12.02	NA	0
	RC-2	12.86	13.50	0.64	0.42
	RC-3	NP	12.37	NA	0
	RC-4	12.81	13.85	1.04	0.68

The CMS proposed the evaluation of high-vacuum multi-phase extraction (HVMPE) to remove LNAPL and other residual VOCs at AOCs A and B. The CMS specified that a pilot study should be performed to determine the potential effectiveness and feasibility of HVMPE in these areas.

The Corrective Measures Pre-Design Activities Work Plan outlined procedures for conducting a HVMPE pilot test at recovery wells RC-1 through RC-4. The effectiveness of the technology was to be evaluated based on the quantity of LNAPL that the system was able to remove in comparison to the current LNAPL recovery efficacy and cost.

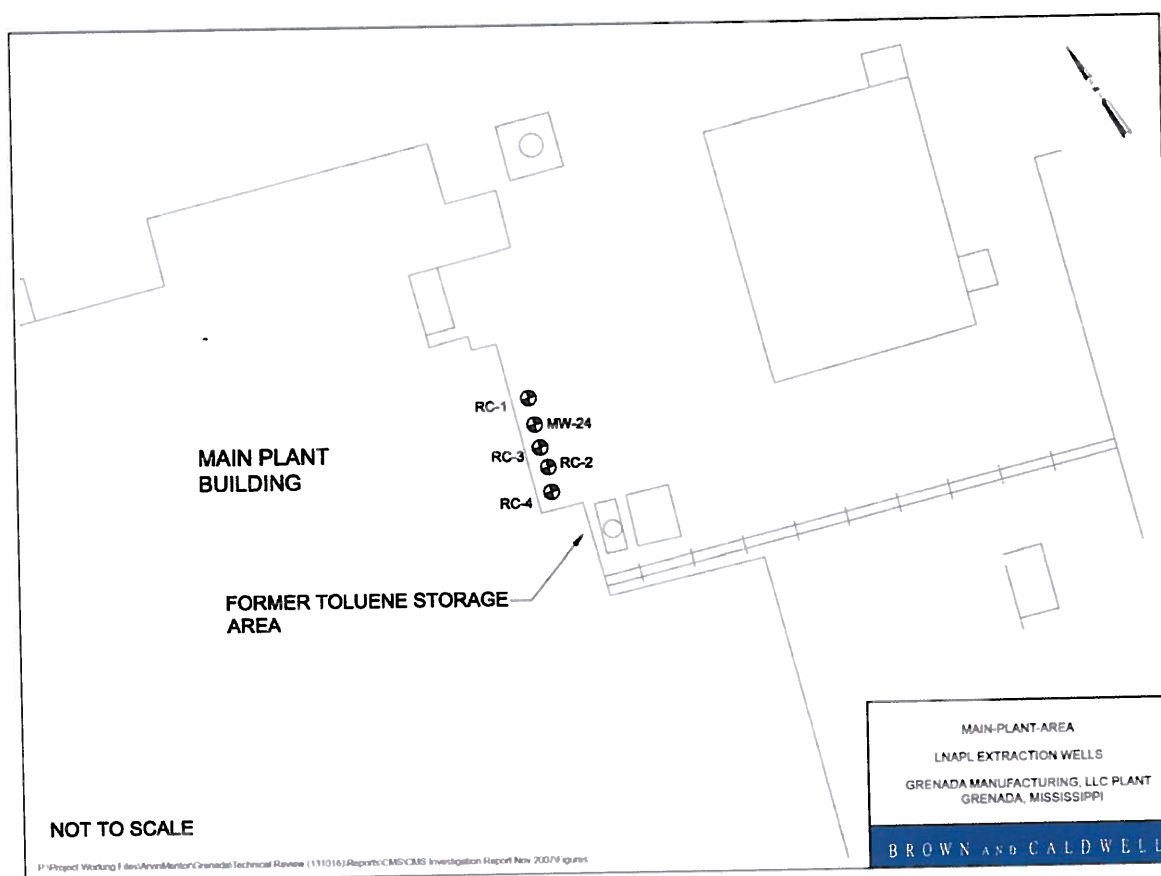


Figure 6-1: Existing Recovery Well Locations

6.2 Approach

An HVMPE pilot test was conducted on October 16, 2007. Pictures showing the components of the test apparatus are shown in Figure 6-2. The design included a 15-foot long, 1-inch diameter aluminum-pipe drop tube that extended through a well cap that sealed the top of the extraction well. The cap was designed with two openings: one was fitted with a vacuum gage and the other sealed off the aluminum pipe. The pipe was plumbed to a flow-control apparatus that included an in-line sight glass, vacuum gage, ball valve to control the vacuum at the well head and the extraction flow from the well, and a ball valve with an auxiliary air intake to control the vacuum between the vacuum truck and the extraction flow-control valve. The apparatus was connected to a 3,000 gallon vacuum truck via a 2-inch diameter cam-lock vacuum hose. The vacuum truck exhaust port was connected to a granular activated carbon (GAC) canister to prevent vapor escape. Recovery wells that were not undergoing testing, and MW-24, were sealed with well plugs to prevent short circuiting during the test.

The HVMPE apparatus was first installed into RC-4. Before inserting the drop tube, the depths to the LNAPL and groundwater were measured and recorded, and the depth from the top of casing to the LNAPL-water interface was marked on the drop tube for positioning. The extraction apparatus was then placed in the well so that the bottom of the drop tube was located at the LNAPL-groundwater interface. The well cap was tightened to seal between the well casing and cap, and the cap and the drop tube.

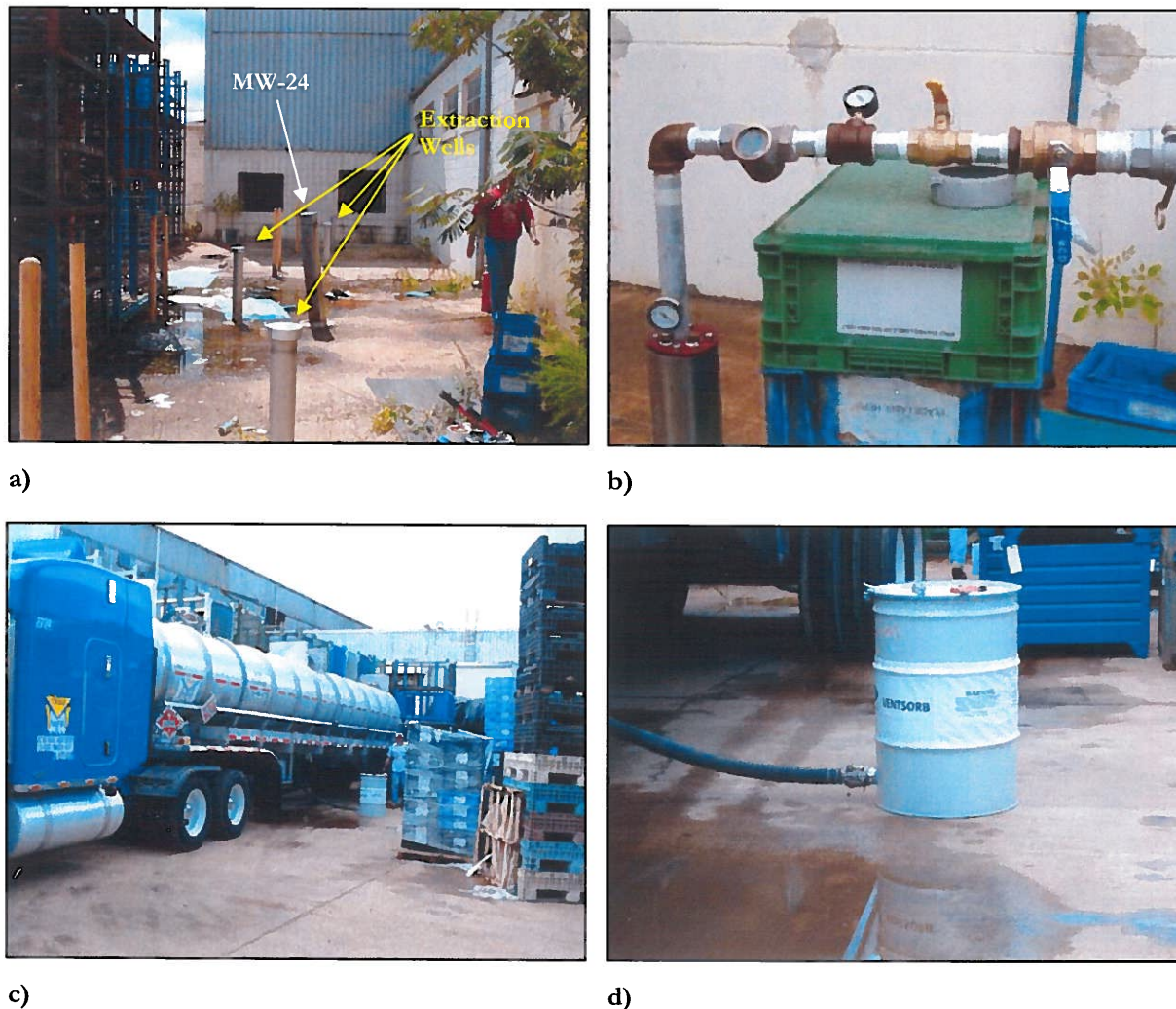


Figure 6-2: HVMPE Setup: a) Existing Extraction Wells; b) Well-head Completion and Flow Control Apparatus; c) Vacuum Truck; d) Off-gas Treatment Unit

System operation entailed establishing the vacuum in the truck and feed line up to the vacuum-control ball valve. The connections were checked for leaks, and none were found. The vacuum-control ball valve was then opened slightly to apply the vacuum in the flow-control apparatus. Next the flow-control ball valve was opened just enough to establish a 10 to 15-inch Hg vacuum in the drop tube. The sight glass was monitored for fluid flow. Water and emulsified product being slurped from the well were observed through the sight glass. The off-gas from the GAC was checked with a PID, and no VOCs were detected. When only water was observed to be flowing in the sight glass, the ball-valve controlling the vacuum on the well was closed and the subsurface was allowed to re-equilibrate. The extraction was then repeated. The process was repeated a third time on RC-4. For RC-2, the drop tube was adjusted, and the system remained on to attempt to draw more LNAPL to the well.

6.3 Results

The depth to LNAPL and groundwater measurements made in the four extraction wells prior to operating the extraction system are shown in Table 6-2. The data show that the depths to groundwater had increased by between approximately 5.5 and 10.5 inches in RC-4 and RC-2, respectively, from the levels measured in August 2007. The changes in water levels were accompanied by an increase in LNAPL thickness of approximately 4.3 inches in RC-2 and a 1.2 -inch decrease in LNAPL thickness in RC-4.

Table 6-2: LNAPL Measurements in the Four Extraction Wells at the Main Plant

Date	Well ID	Depth to LNAPL (feet TOC)	Depth to Water (feet TOC)	Product Thickness (feet)
Initial readings 10-16-07	RC-1	NP	12.41	0.00
	RC-2	13.36	14.36	1.00
	RC-3	NP	13.06	0.00
	RC-4	13.38	14.32	0.94

The vacuum levels measured in the extraction apparatus and the active extraction well, along with the observed effects regarding LNAPL recovery, are noted in Table 6.3. When the vacuum in the extraction apparatus reached 8 inches of Hg, the LNAPL residing within the well casing was rapidly pulled from the well. When the vacuum in the extraction apparatus reached its high of 13 inches of Hg, emulsified LNAPL was being extracted, indicating that groundwater and vadose-zone vapor were being entrained in the extracted fluid. A vacuum level of 13 inches of Hg did not cause a noticeable effect in any of the adjacent extraction wells.

Table 6-3: LNAPL Extraction in Well RC-4

Well ID	Vacuum in Apparatus, inches Hg	Vacuum in Well	Observed Effects
RC-4	0	0	None
	5	0	None
	8	0	LNAPL Removed
	13	0	Emulsified LNAPL, Water Removed

After approximately 5 minutes of operation, visual observations through the sight glass indicated that no additional LNAPL was being removed. The system was turned off and allowed to equilibrate for 20 minutes. After the 20 minutes, the ball-valve was reopened and only water was observed to be flowing through the sight glass. After 5 minutes of operation, the vacuum was turned off and LNAPL and water-level measurements were made over the next 18 hours to monitor for rebound and for the recovery of the water table (Table 6-3). It was determined that the volume of LNAPL that could be effectively removed from RC-4 using HVMPE had been achieved, so the extraction apparatus was moved to RC-2.

Table 6-4: LNAPL and Groundwater Levels in RC-4 after Vacuum Extraction

Recovery Duration	Depth to LNAPL (feet TOC)	Depth to Water (feet TOC)	LNAPL Thickness (feet)
25 minutes	13.42	13.43	0.01
90 minutes	13.39	13.40	0.01
18 hours	13.39	13.87	0.48

Upon startup on RC-2, the system rapidly achieved a vacuum of 13-inches of Hg, and the pure-phase LNAPL residing in the well was rapidly removed. This was followed by a period of approximately 5 minutes when emulsified LNAPL was observed in the sight glass. In order to maintain a “slurping” effect, the drop tube was raised several times because the groundwater level in the well steadily increased. The drop tube was raised a total of 1 foot to maintain slurping. The vacuum on the apparatus fluctuated between 15 and 20-inches Hg while slurping continued. A vacuum of 2 inches Hg was observed in Well RC-2, and the extraction apparatus remained functioning to maintain that vacuum level. The vacuum increased to about 4 inches Hg and then steadied at 3.5 inches Hg. Readings on the other three extraction wells showed no vacuum from the extraction at RC-2. Slurping continued for approximately 80 minutes until only groundwater was observed in the sight glass, at which time the valves were closed and the system allowed to recover overnight before LNAPL and water-level measurements were recorded.

The LNAPL-recovery results at RC-2 were similar to those observed at RC-4, where the LNAPL standing in the well was quickly removed upon system startup, and no additional LNAPL was recovered once that material was removed. The depths to LNAPL and groundwater were measured 16 hours after the vacuum extraction system on RC-2 was turned off. The results are shown in Table 6-4. The water levels were measured in the three other recovery wells and those data also are included in Table 6-4.

Table 6-5: LNAPL Measurements in the Four Extraction Wells at the Main Plant

Date	Well ID	Depth to LNAPL (feet)	Depth to Water (feet)	LNAPL Thickness (feet)
Recovery after 16 hrs 10-17-07	RC-1	NP	12.41	0
	RC-2	13.52	13.53	0.01
	RC-3	NP	13.06	0
	RC-4	13.39	13.87	0.48

The depth to groundwater data show no impact at RC-1 or RC-3 from the testing on the two extraction wells. The depths to water in RC-2 and RC-4 decreased during system operation, and the impact remained detectable after the 16-hour recovery period with decreased depths to water measured at 0.83 feet in RC-2 and 0.45 feet in RC-4. The thickness of the LNAPL in RC-2 and RC-4 rebounded to 0.12 and 5.76 inches, respectively. These observed trends in the limited radius of influence from the vacuum and associated lifting of the water table, the short duration of product recovery during application of the vacuum, and the combined trends in LNAPL thickness and rebounding as a function of water table recovery indicated that vacuum-enhanced recovery was not a suitable LNAPL removal technology for the former LNAPL in the former toluene storage-tank area.

Periodic monitoring with a PID showed no presence of toluene vapors in the system off-gas. Examination of the wells the following day showed limited recharge in Wells RC-2 and RC-4, which suggests that the toluene still present in the soil will be difficult to recover and that migration of the plume is unlikely. Indoor air

monitoring shows that no vapors have escaped into the building and that the potential for exposure is minimal.

6.4 Recommendations

Based on the minimal recovery of LNAPL and the lifting of the water table, implementation of high-vacuum multiphase extraction is not recommended for the Site. The slow rebound of LNAPL suggests that a more passive method of recovery should be considered; such as manual recovery with a bailer if it is determined that the LNAPL poses a risk to site workers and/or the environment. To date, there has been no observable toluene plume in groundwater emanating from the LNAPL at concentrations above the MCL, and indoor-air sampling has shown there to be no risk through the vapor intrusion pathway into the on-site buildings. If the results of paired indoor-air sampling events confirm that TCE and toluene are not impacting indoor air quality, LNAPL recovery should be done through manual bailing and toluene should remain as an analyte in the groundwater monitoring program.

There are several benefits to not removing the LNAPL at the Site. As mentioned, toluene has not been detected in any of the downgradient wells above MCLs. Based on the length of time that has elapsed since the LNAPL was introduced to the subsurface, it appears that any toluene that dissolves into the groundwater is naturally attenuating; and it is highly unlikely that toluene will be detected above MCLs in the groundwater in the future. In fact, toluene that does dissolve into the groundwater is likely being used by indigenous microorganisms, which in turn are creating the reducing conditions needed to support biologically mediated reductive dechlorination of TCE which is present in the groundwater. Bacteria capable of reductive dechlorination of TCE are likely using the toluene, or the hydrogen resulting from associated fermentation of toluene, as a substrate/electron donor to dechlorinate TCE originating from the source at AOC A. Toluene is known to be a suitable electron donor for the bacteria that degrade TCE through its daughter products and ultimately to ethene.

The microbial breakdown of TCE will not occur if reducing conditions in the aquifer are not maintained and if a supply of a suitable electron donor is not available. Aggressive removal of the residual toluene could remove the substrate that is maintaining the reducing condition and eliminate the supply of electron donor. The net result could be the elimination of beneficial reductive dechlorination, which could ultimately result in increased concentrations and mass of TCE reaching the PRB and, more importantly, could lead to a longer time period before the aquifer can be returned to beneficial use.

Another benefit of leaving the LNAPL in place is associated with the longevity of the zero-valent iron in the PRB. Toluene supports microbially mediated nitrate and sulfate reduction, which could lower the mass of these ions encountered at the PRB. Lowering this mass can reduce the rate of premature iron passivation. The zero-valent iron in the PRB becomes coated over time by chemical reactions that occur with inorganic compounds present in the groundwater flowing through the wall. Over time, this coating reduces the ability of the PRB to treat the chlorinated solvents to the point that the reactive capacity of the wall must be restored. The frequency of these required restoration events is largely dictated by the geochemistry of the influent groundwater. The presence of toluene and other microbial food sources in the groundwater system will result in the removal of sulfate, nitrate, and other oxidized compounds that lead to coating of the zero-valent iron. In addition, the aggressive removal of toluene from the source area would result in the introduction of oxygen to the groundwater (a contributing factor to the formation of coatings on the iron). Because the presence of dissolved-phase toluene in the groundwater system from this residual source could improve the performance of the PRB, it is recommended to not attempt to aggressively remove it.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

7. INSTITUTIONAL CONTROLS

7.1 Background

Institutional controls are often used at sites to ensure limited exposure to contaminants during remediation as well as contaminants left in place. Currently there are covenants and restrictions specified in the Notice of Use Restrictions (Book 331, Page 102-107 and Book 332, Page 165-169). These deed restrictions for the property were negotiated with USEPA and deemed to be "interim" in nature. The CMS specified the evaluation of the need for additional institutional controls such as warning signs to notify site workers and visitors of residual risks and to closely control access/use of the Site and possibly deed restrictions. Periodic inspections and routine maintenance of existing controls were also specified.

7.2 Approach

The existing institutional controls were identified and evaluated for their effectiveness in achieving the goal of protecting site workers and visitors from the risks associated with contacting or being exposed to the COCs at the Site.

7.3 Results

Existing institutional controls in place at the Site include signs on fencing around the Main-Plant buildings and the wastewater treatment plant/Sludge Lagoon Areas, signage indicating limited access and/or the presence of conditions that warrant caution, and the aforementioned deed restrictions. These institutional controls are recorded with the Chancery Clerk's Office of Grenada County in the State of Mississippi in Book 331 on pages 102 through 107 and Book 332 on pages 165 through 169 and can be found in Appendix E of this report. In summary, the controls specify that:

1. No persons shall install any groundwater wells or extract the groundwater in the uppermost aquifer located at or underlying the Property for any purpose, potable or non-potable, except for groundwater sampling, groundwater investigation, or remedial activities, as warranted and approved by the U.S. EPA and/or MDEQ.
2. The Property is restricted to non-residential use only, and shall not be used as a hospital, school, day care facility, or other child-occupied facility, as those terms may be currently defined, or defined in the future, by zoning ordinance(s) of the City of Grenada or any other local governmental entity with jurisdiction and authority to regulate the land use at the Property.
3. There shall be no surface or subsurface demolition, excavation, drilling or other similar activities in the former chrome plating line area of the Property identified on Exhibit B without the prior written approval of the U.S. EPA and MDEQ.
4. Owner grants access to the Property at all reasonable times to the U.S. EPA, the MDEQ, and any private persons (including their contractors, subcontractors and agents) who have not otherwise been granted access to the Property and who are authorized by the U.S. EPA and/or the MDEQ to undertake environmental activities on the Property relating in any way to the State of Mississippi Hazardous Waste Management Permit No. HW-007-037-278 or U.S. EPA RCRA Permit No. MSD

007 037 278. All parties obtaining or granted access to the Property under this provision shall conduct their activities on the Property in a manner which minimizes to the fullest extent possible any disruptions to the use and enjoyment of the Property by Owner, its successors or assigns, and/or any other persons having an ownership or property interest in the Property.

Based on the hydrogeology at the site, the nature and depth of the contamination, the results of several rounds of indoor air sampling, and the nature of the ongoing manufacturing operations, it was determined that the existing deed restrictions were protective of the site.

7.4 Recommendations

The existing institutional controls at the site are adequate for protecting site workers and visitors from potential risks. The following recommendations are made based on increasing the level of awareness of people entering AOCs, or to secure systems and minimize the potential for tampering and/or unauthorized access to wells.

1. Temporary signs indicating the hazards of walking onto the sludge in the Sludge-Lagoon Area should be posted at the main gate to the wastewater treatment plant and around the lagoon perimeter. The signage should be updated upon lagoon closure.
2. Signs indicating the presence of the PRB and instructing "No Digging" should be posted along the length of the PRB.
3. The PRB is a passive technology designed to treat contamination before it reaches Riverdale Creek. As such, the technology relies on groundwater flow to transport the contamination from the source area to the barrier location. The current property use restrictions are protective for the site under that scenario. It is recommended that the existing covenants and restrictions remain in place. It also is recommended that those covenants and restriction be reviewed every 5 years to determine if they remain protective, and/or if they are still needed to be protective.
4. Because the Sludge Lagoon will be closed with the sludge left in place, deed restrictions similar to those in use for the Chrome Plating Line will be established and specified in the permit.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

8. SUMMARY OF RECOMMENDATIONS

8.1 NAPL Delineation

Regular monitoring in July, August, and October 2007 showed that recoverable DNAPL is no longer present in AOC A. The temporary wells in the Main-Plant Area should therefore be abandoned. The remaining permanent monitoring wells located in the Main-Plant Area will be tested regularly, and any change in the groundwater status will be quickly recognized and managed.

The temporary wells installed around the perimeter of the Sludge Lagoon showed that neither LNAPL nor DNAPL were present in that area. It is recommended that the site-wide groundwater monitoring program continue and the temporary wells be abandoned according to Mississippi requirements.

8.2 Vadose Zone Contamination in the Sludge-Lagoon Area

Soil borings collected around the Sludge-Lagoon Area showed only two spots where VOC detections were elevated. Step-out borings collected near these “hot spots” showed no evidence of vadose zone contamination. Data obtained from this investigation will be used to define the extent of the cap system that will be placed over the lagoon area following sludge stabilization.

8.3 Sludge Characterization and Treatability Testing

The chemical stabilization analyses performed by KEMRON Environmental indicate that combination of the lagoon sludge with Type I Portland Cement and lime kiln dust provides adequate stabilization to prevent migration and to support a capping system. It is recommended that the sludge be stabilized in place and that a cap be placed over it. An impermeable cap design is planned that will likely include a 60-mL thick HDPE membrane, and a geocomposite drainage layer, 18 inches of common borrow soil, and 6 inches of soil to support grass growth. Detailed specifications and accompanying engineering drawings will be included in the Sludge Lagoon Closure Plan.

8.4 Sheet-Pile Barrier & Groundwater Modeling

Results of the model simulation show that no significant gain in contaminant reduction or control would be achieved should a sheet-pile barrier be installed. Additionally, concentrations of TCE in the Main-Plant Area have steadily declined since the installation of the PRB Wall. It is recommended that no further investigation be performed in this area and that a sheet-pile barrier not be installed.

8.5 High Vacuum Multi-phase Extraction

The High-vacuum multi-phase pilot test on wells RC-4 and RC-2 in AOC B resulted in minimal enhancement to product recovery. Water level data indicated that the water table was raised when the vacuum was applied. Significant vapor flow from the soils did not occur nor did an increase in LNAPL movement to the wells occur. It is recommended that more passive strategies be employed, such as manual extraction with Teflon™ bailers. Well monitoring and sampling is performed on a regular basis, and manual toluene recovery can be done at the same time intervals.

8.6 Institutional Controls

Additional signage should be posted at the PRB and Sludge-Lagoon Area. The existing property use restrictions should remain in effect and be evaluated at 5-year intervals. No additional deed restrictions are needed.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

9. DECONTAMINATION AND INVESTIGATION-DERIVED WASTE

9.1 Site Procedures

Field equipment, such as non-dedicated sampling or down-hole measurement equipment, was decontaminated between each well location following the procedures outlined in the approved PMP and QAPP. All purge water, soil cuttings, and decontamination water collected during the sampling event was segregated, placed into Department of Transportation (DOT)-approved 55-gallon drums, and stored on-site. Previous groundwater analyses were used to characterize the purge water for transportation and disposal by a licensed waste transporter retained by ArvinMeritor. BC provided ArvinMeritor with the number of drums, estimated volume of water and soil, and previous analytical results. Additionally, BC clearly labeled each drum including contents and date, as required for proper storage. The waste transporter developed the waste disposal manifests and delivered them to ArvinMeritor for signing. The waste transporter then labeled each drum for transport and removed them under manifest for disposal on ArvinMeritor's behalf.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

10. LIMITATIONS

Report Limitations

This document was prepared solely for ArvinMeritor, Inc. in accordance with professional standards at the time the services were performed. This document is governed by the specific scope of work authorized by ArvinMeritor, Inc.; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work.

CORRECTIVE MEASURES PRE-DESIGN INVESTIGATION RESULTS

11. REFERENCES

- Brown and Caldwell, (July 2006). Corrective Measures Pre-Design Activities Work Plan, Grenada Manufacturing, LLC, Grenada, Mississippi, prepared for ArvinMeritor, Inc.
- Brown and Caldwell, (June 2004). Baseline Groundwater, Surface Water, and Sediment Sampling Report, Grenada, Manufacturing, Grenada, Mississippi, prepared for ArvinMeritor, Troy, Michigan.
- Brown and Caldwell, (August 2003). Corrective Measures Study, Grenada Manufacturing, LLC, Grenada, Mississippi. EPA I.D. No. MSD 007 037 278.
- Brown and Caldwell, (January 2001). RCRA Facility Investigation Report, prepared for Grenada Manufacturing Facility, Grenada, Mississippi, Revised October 2001.
- USEPA, (September 1998). Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water. EPA/600/R-98/128.

APPENDIX A

NAPL Well Data

FLUID LEVEL MEASUREMENTS
GRENADA PRB WALL EVALUATION
 GRENADA, MISSISSIPPI
 JULY 2007

Location	Date	TOC Elevation (msl)	Ground Surface Elevation (msl)	Depth to LNAFL (ft)	DTW (ft)	Depth to DNAPL (ft)	Total Depth (ft)	Well PID (ppm)	Groundwater Elevation (msl)	Notes
Lagoon Area Temporary Wells										
LTW-1	7/20/2007	TBD	TBD	-	13.99	NA	20.30	0.5	TBD	
LTW-2	7/20/2007	TBD	TBD	NA	14.89	-	52.60	3.0	TBD	
LTW-3	7/20/2007	TBD	TBD	-	14.81	NA	20.15	15	TBD	
LTW-4	7/20/2007	TBD	TBD	-	14.50	-	53.50	25	TBD	
LTW-5	7/20/2007	TBD	TBD	-	13.40	NA	20.20	>1,000	TBD	
LTW-6	7/20/2007	TBD	TBD	NA	13.43	-	18.65	530	TBD	
LTW-7	7/20/2007	TBD	TBD	-	13.40	NA	49.25	2.0	TBD	
LTW-8	7/20/2007	TBD	TBD	NA	14.25	NA	20.30	175	TBD	
LTW-9	7/20/2007	TBD	TBD	-	14.16	-	49.20	1.0	TBD	
LTW-10	7/20/2007	TBD	TBD	-	12.87	NA	20.25	>1,000	TBD	
LTW-11	7/20/2007	TBD	TBD	NA	14.31	-	49.03	0.3	TBD	
LTW-12	7/20/2007	TBD	TBD	-	10.80	NA	19.30	>1,000	TBD	
LTW-13	7/20/2007	TBD	TBD	-	10.76	-	48.08	150	TBD	
LTW-14	7/20/2007	TBD	TBD	-	13.37	NA	19.50	800	TBD	
LTW-15	7/20/2007	TBD	TBD	NA	13.40	-	47.95	>1,000	TBD	
LTW-16	7/20/2007	TBD	TBD	-	9.90	NA	18.40	>1,000	TBD	
LTW-17	7/20/2007	TBD	TBD	NA	9.86	-	44.65	180	TBD	
LTW-18	7/20/2007	TBD	TBD	-	-	-	-	-	-	
Plant Area Temporary Wells										
PTW-A1	7/24/2007	TBD	TBD	NA	9.35	-	53.21	NA	TBD	Flush
PTW-A2	7/24/2007	TBD	TBD	NA	9.09	-	53.65	NA	TBD	Flush
PTW-A3	7/24/2007	TBD	TBD	NA	9.02	-	54.75	NA	TBD	Flush
PTW-A4	7/25/2007	TBD	TBD	NA	8.98	-	54.32	NA	TBD	Flush
PTW-A5	7/25/2007	TBD	TBD	NA	8.96	-	54.44	NA	TBD	Stickup
PTW-A6	7/21/2007	TBD	TBD	NA	10.92	-	54.80	NA	TBD	Flush
PTW-B1	7/24/2007	TBD	TBD	NA	9.39	-	51.41	NA	TBD	Flush
PTW-B2	7/20/2007	TBD	TBD	NA	9.36	-	51.85	NA	TBD	Flush
PTW-B3	7/20/2007	TBD	TBD	NA	9.45	-	53.70	NA	TBD	Flush
PTW-B4	7/20/2007	TBD	TBD	NA	9.55	-	54.40	NA	TBD	Flush
PTW-B5	7/20/2007	TBD	TBD	NA	12.42	-	58.07	NA	TBD	Stickup
PTW-B6	7/20/2007	TBD	TBD	NA	10.83	-	55.10	NA	TBD	Stickup
PTW-C1	7/24/2007	TBD	TBD	NA	9.40	-	51.15	NA	TBD	Flush
PTW-C2	7/20/2007	TBD	TBD	NA	9.22	-	51.00	NA	TBD	Flush
PTW-C3	7/19/2007	TBD	TBD	NA	8.92	-	50.85	NA	TBD	Flush
PTW-C4	7/19/2007	TBD	TBD	NA	9.03	-	53.08	NA	TBD	Stickup
PTW-C5	7/19/2007	TBD	TBD	NA	9.86	-	54.65	NA	TBD	Stickup
PTW-C6	7/19/2007	TBD	TBD	NA	11.28	-	54.70	NA	TBD	Stickup
PTW-D1	7/24/2007	TBD	TBD	NA	9.19	-	51.25	NA	TBD	Flush

FLUID LEVEL MEASUREMENTS
GRENADA PRB WALL EVALUATION
 GRENADA, MISSISSIPPI
 JULY 2007

Location	Date	TOC Elevation (msl)	Ground Surface Elevation (msl)	Depth to LNAPL (ft)	DTW (ft)	Depth to DNAPL (ft)	Total Depth (ft)	Well PID (ppm)	Groundwater Elevation (msl)	Notes
PTW-D2	7/20/2007	TBD	TBD	NA	9.49	-	52.80	NA	TBD	Flush
PTW-D3	7/19/2007	TBD	TBD	NA	9.05	-	53.02	NA	TBD	Flush
PTW-D4	7/19/2007	TBD	TBD	NA	9.10	-	53.10	NA	TBD	Flush
PTW-D5	7/21/2007	TBD	TBD	NA	9.83	-	54.65	NA	TBD	Stickup
PTW-D6	7/19/2007	TBD	TBD	NA	11.67	-	53.90	NA	TBD	Stickup
PTW-E1	7/24/2007	TBD	TBD	NA	9.17	-	53.38	NA	TBD	Flush
PTW-E2	7/19/2007	TBD	TBD	NA	8.95	-	52.20	NA	TBD	Flush
PTW-E3	7/21/2007	TBD	TBD	NA	9.12	-	52.3	NA	TBD	Flush
PTW-E4	7/19/2007	TBD	TBD	NA	9.42	-	52.60	NA	TBD	Stickup
PTW-E5	7/19/2007	TBD	TBD	NA	11.26	-	52.00	NA	TBD	Stickup
PTW-E6	7/19/2007	TBD	TBD	NA	11.55	-	56.20	NA	TBD	Stickup
PTW-AA5	7/25/2007	TBD	TBD	NA	11.59	-	55.10	NA	TBD	Stickup
MW-27	7/24/2007	TBD	TBD	NA	9.23	-	55.10	NA	TBD	Existing flush well. DNAPL previously detected.
MW-28	7/24/2007	TBD	TBD	NA	9.05	-	53.75	NA	TBD	Existing flush well. DNAPL previously detected.

Notes:

- All measurements are relative to TOC reference mark.
- TBD = To Be Determined after survey.
- NA = Not Applicable
- PID measurement obtained upon opening well using a MiniRAE 10.6 eV PID.

FLUID LEVEL MEASUREMENTS
GRENADA PRB WALL EVALUATION
 GRENADA, MISSISSIPPI
 AUGUST 2007

Location	Date	TOC Elevation (msl)	Ground Surface Elevation (msl)	Depth to LNAPL (ft)	DTW (ft)	Depth to DNAPL (ft)	Total Depth (ft)	Well PID (ppm)	Groundwater Elevation (msl)	Notes
Lagoon Area Temporary Wells										
L1W-1	8/28/07	TBD	TBD	-	14.55	NA	20.31	0.5	TBD	
L1W-2	8/28/07	TBD	TBD	NA	15.48	-	51.56	3.0	TBD	
L1W-3	8/28/07	TBD	TBD	-	15.56	NA	20.10	15	TBD	
L1W-4	8/28/07	TBD	TBD	NA	15.20	-	53.60	25	TBD	
L1W-5	8/28/07	TBD	TBD	-	14.08	NA	20.29	5.0	TBD	
L1W-6	8/28/07	TBD	TBD	NA	14.57	-	52.75	>1,000	TBD	
L1W-7	8/28/07	TBD	TBD	-	13.96	NA	18.90	530	TBD	
L1W-8	8/28/07	TBD	TBD	NA	16.02	-	49.80	2.0	TBD	
L1W-9	8/28/07	TBD	TBD	NA	14.84	NA	20.33	175	TBD	
L1W-10	8/28/07	TBD	TBD	NA	14.85	-	49.22	1.0	TBD	
L1W-11	8/28/07	TBD	TBD	-	13.42	NA	20.26	>1,000	TBD	
L1W-12	8/28/07	TBD	TBD	NA	15.19	-	49.20	0.3	TBD	
L1W-13	8/28/07	TBD	TBD	NA	11.61	-	48.10	150	TBD	
L1W-14	8/28/07	TBD	TBD	-	14.57	NA	19.50	800	TBD	
L1W-15	8/28/07	TBD	TBD	NA	14.35	-	47.82	>1,000	TBD	
L1W-16	8/28/07	TBD	TBD	-	11.04	NA	18.36	>1,000	TBD	
L1W-17	8/28/07	TBD	TBD	NA	10.90	-	44.82	180	TBD	
L1W-18	8/28/07	TBD	TBD	-	-	-	-	-	-	
Plant Area Temporary Wells										
PTW-A1	8/27/07	TBD	TBD	NA	9.86	-	53.05	NA	TBD	Flush
PTW-A2	8/27/07	TBD	TBD	NA	9.54	-	52.45	NA	TBD	Flush
PTW-A3	8/27/07	TBD	TBD	NA	9.57	-	54.80	NA	TBD	Flush
PTW-A4	8/27/07	TBD	TBD	NA	9.50	-	54.15	NA	TBD	Flush
PTW-A5	8/27/07	TBD	TBD	NA	9.50	-	53.45	NA	TBD	Stickup
PTW-A6	8/27/07	TBD	TBD	NA	11.46	-	54.60	NA	TBD	Flush
PTW-B1	8/27/07	TBD	TBD	NA	9.90	-	51.25	NA	TBD	Flush
PTW-B2	8/27/07	TBD	TBD	NA	9.91	-	51.83	NA	TBD	Flush
PTW-B3	8/28/07	TBD	TBD	NA	9.96	-	51.90	NA	TBD	Flush
PTW-B4	8/28/07	TBD	TBD	NA	10.12	-	54.20	NA	TBD	Well broken off at ground surface
PTW-B5	8/27/07	TBD	TBD	NA	10.07	-	53.45	NA	TBD	Stickup
PTW-B6	8/27/07	TBD	TBD	NA	9.92	-	55.00	NA	TBD	Flush
PTW-C1	8/27/07	TBD	TBD	NA	9.71	-	51.00	NA	TBD	Flush
PTW-C2	8/28/07	TBD	TBD	NA	9.71	-	50.95	NA	TBD	Flush
PTW-C3	8/28/07	TBD	TBD	NA	9.40	-	50.51	NA	TBD	Flush
PTW-C4	8/28/07	TBD	TBD	NA	9.66	-	52.85	NA	TBD	Flush
PTW-C5	8/27/07	TBD	TBD	NA	10.38	-	54.14	NA	TBD	Stickup
PTW-C6	8/27/07	TBD	TBD	NA	11.85	-	54.70	NA	TBD	Stickup
PTW-D1	8/27/07	TBD	TBD	NA	9.70	-	49.25	NA	TBD	Flush

PTW-D2	X	TBD	TBD	NA	X	-	X	NA	TBD	Flush
PTW-D3	X	TBD	TBD	NA	X	-	X	NA	TBD	Flush
PTW-D4	X	TBD	TBD	NA	X	-	X	NA	TBD	Flush
PTW-D5	8/27/07	TBD	TBD	NA	10.36	-	54.50	NA	TBD	Stickup
PTW-D6	8/27/07	TBD	TBD	NA	12.21	-	53.80	NA	TBD	Stickup
PTW-E1	8/27/07	TBD	TBD	NA	9.70	-	51.70	NA	TBD	Flush
PTW-E2	X	TBD	TBD	NA	X	-	X	NA	TBD	Flush
PTW-E3	8/28/07	TBD	TBD	NA	9.64	-	52.30	NA	TBD	Flush
PTW-E4	8/28/07	TBD	TBD	NA	9.99	-	52.40	NA	TBD	Flush
PTW-E5	8/27/07	TBD	TBD	NA	11.55	-	49.15	NA	TBD	Stickup
PTW-E6	8/27/07	TBD	TBD	NA	12.08	-	56.20	NA	TBD	Stickup
PTW-AA5	8/27/07	TBD	TBD	NA	12.12	-	55.10	NA	TBD	Stickup
MW-26	8/27/07	TBD	TBD	NA	9.30	-	22.80	NA	TBD	Existing flush well.
MW-27	8/27/07	TBD	TBD	NA	9.76	53.20	55.10	NA	TBD	Could not visually confirm DNAPL presence
MW-27	8/28/07	TBD	TBD	NA	9.80	53.20	55.10	NA	TBD	Repeat to double check DNAPL presence
MW-28	8/27/07	TBD	TBD	NA	9.58	-	53.90	NA	TBD	Existing flush well. DNAPL previously detected.
MW-29	8/29/07	TBD	TBD	NA	9.42	-	52.65	NA	TBD	Existing flush well.
MW-30	8/28/07	TBD	TBD	NA	9.78	-	50.55	NA	TBD	Curb box broken, filled hole with gravel so flush, possible trace of LNAPL

Notes:

- All measurements are relative to TOC reference mark.
- TBD = To Be Determined after survey.
- NA = Not Applicable
- PID measurement obtained upon opening well using a MiniRAE 10.6 eV PID.

FLUID LEVEL MEASUREMENTS
GRENADA PRP WALL EVALUATION
 GRENADA, MISSISSIPPI
 October-07

Location	Date	TOC Elevation (msl)	Ground Surface Elevation (msl)	Depth to LNAPL (ft)	DTW (ft)	Depth to DNAPL (ft)	Total Depth (ft)	Well PID (ppm)	Groundwater Elevation (msl)	Notes
Lagoon Area Temporary Wells										
LTV-1	10/17/07	TBD	TBD	-	14.81	NA	20.04		TBD	
LTV-2	10/17/07	TBD	TBD	NA	15.75	-	51.42		TBD	
LTV-3	10/17/07	TBD	TBD	-	15.79	NA	20.13		TBD	
LTV-4	10/17/07	TBD	TBD	NA	15.45	-	54.63		TBD	
LTV-5	10/17/07	TBD	TBD	-	14.29	NA	20.04		TBD	
LTV-6	10/17/07	TBD	TBD	NA	14.31	-	52.82		TBD	
LTV-7	10/17/07	TBD	TBD	-	14.33	NA	18.83		TBD	
LTV-8	10/17/07	TBD	TBD	NA	15.35	-	49.93		TBD	
LTV-9	10/17/07	TBD	TBD	-	15.16	NA	20.35		TBD	
LTV-10	10/17/07	TBD	TBD	NA	15.11	-	49.89		TBD	
LTV-11	10/17/07	TBD	TBD	-	13.62	NA	19.92		TBD	
LTV-12	10/17/07	TBD	TBD	NA	15.54	-	49.56		TBD	
LTV-13	10/17/07	TBD	TBD	-	12.80	NA	18.75		TBD	
LTV-14	10/17/07	TBD	TBD	NA	11.86	-	14.05		TBD	
LTV-15	10/17/07	TBD	TBD	-	14.83	NA	19.50		TBD	
LTV-16	10/17/07	TBD	TBD	NA	14.65	-	47.20		TBD	
LTV-17	10/17/07	TBD	TBD	-	11.30	NA	18.10		TBD	
LTV-18	10/17/07	TBD	TBD	NA	11.17	-	43.50		TBD	
Plant Area Temporary Wells										
PTW-A1	10/16/07	TBD	TBD	NA	10.30	-	51.72	NA	TBD	Flush
PTW-A2	10/17/07	TBD	TBD	NA	9.55	-	52.45	NA	TBD	Flush
PTW-A3	10/17/07	TBD	TBD	NA	9.99	-	54.63	NA	TBD	Flush
PTW-A4	10/16/07	TBD	TBD	NA	9.91	-	54.00	NA	TBD	Flush
PTW-A5	10/16/07	TBD	TBD	NA	9.92	-	53.30	NA	TBD	Flush
PTW-A6	10/16/07	TBD	TBD	NA	11.90	-	54.30	NA	TBD	Stickup
PTW-A81	10/16/07	TBD	TBD	NA	10.36	-	50.45	NA	TBD	Flush
PTW-A82	10/16/07	TBD	TBD	NA	10.30	-	51.70	NA	TBD	Flush
PTW-A83	10/16/07	TBD	TBD	NA	10.34	-	51.90	NA	TBD	Flush
PTW-B4	10/16/07	TBD	TBD	NA	10.49	-	54.20	NA	TBD	Flush
PTW-B5	10/16/07	TBD	TBD	NA	10.58	-	53.44	NA	TBD	Well broken off at ground surface. Cap replaced
PTW-B6	10/16/07	TBD	TBD	NA	11.79	-	55.00	NA	TBD	Stickup
PTW-C1	10/17/07	TBD	TBD	NA	10.19	-	49.20	NA	TBD	Flush
PTW-C2	10/17/07	TBD	TBD	NA	10.17	-	50.85	NA	TBD	Flush
PTW-C3	10/17/07	TBD	TBD	NA	9.73	-	50.20	NA	TBD	Flush
PTW-C4	10/17/07	TBD	TBD	NA	9.90	-	52.10	NA	TBD	Flush
PTW-C5	10/16/07	TBD	TBD	NA	10.80	-	53.90	NA	TBD	Stickup
PTW-C6	10/16/07	TBD	TBD	NA	12.25	-	54.43	NA	TBD	Stickup
PTW-D1	10/17/07	TBD	TBD	NA	10.39	-	50.70	NA	TBD	Flush

PTW-D2	X	TBD	TBD	NA	X	-	X	NA	TBD	Flush
PTW-D3	X	TBD	TBD	NA	X	-	X	NA	TBD	Flush
PTW-D4	10/16/07	TBD	TBD	NA	9.60	-	52.10	NA	TBD	Flush
PTW-D5	10/16/07	TBD	TBD	NA	10.74	-	54.60	NA	TBD	Stickup
PTW-D6	10/16/07	TBD	TBD	NA	12.64	-	53.75	NA	TBD	Stickup
PTW-E1	10/17/07	TBD	TBD	NA	10.15	-	49.80	NA	TBD	Flush
PTW-E2	10/16/07	TBD	TBD	NA	X	-	X	NA	TBD	Flush
PTW-E3	10/16/07	TBD	TBD	NA	X	-	X	NA	TBD	Flush
PTW-E4	10/16/07	TBD	TBD	NA	10.38	-	52.20	NA	TBD	Stickup
PTW-E5	10/16/07	TBD	TBD	NA	11.71	-	49.03	NA	TBD	Stickup
PTW-E6	10/16/07	TBD	TBD	NA	12.51	-	55.98	NA	TBD	Stickup
PTW-AAS	10/16/07	TBD	TBD	NA	12.53	-	55.15	NA	TBD	Stickup
MMW-26	10/16/07	TBD	TBD	NA	9.74		22.78	NA	TBD	Existing flush well
MMW-27	10/16/07	TBD	TBD	NA	10.19		55.20	NA	TBD	Could not visually confirm DNAPL presence
MMW-28	10/16/07	TBD	TBD	NA	9.99		53.90	NA	TBD	Existing flush well. DNAPL previously detected
MMW-29	10/16/07	TBD	TBD	NA	10.30		53.15	NA	TBD	
MMW-30	10/15/07	TBD	TBD	NA	10.14		50.25	NA	TBD	Curb box broken, filled hole with gravel so flush, possible trace of LNAPL
MMW-24	10/16/07	TBD	TBD	NA	14.13					

Notes:

- All measurements are relative to TOC reference mark.
- TBD = To Be Determined after survey.
- NA = Not Applicable
- PID measurement obtained upon opening well using a MiniRAE 10.6 eV PID.

APPENDIX B

Vadose Zone Soil Boring Summary

SUMMARY OF SLUDGE LAGOON VADOSE ZONE SOIL BORINGS

GRENADA NAPL INVESTIGATION

GRENADA, MISSISSIPPI

JULY 2007

Location	Date	Head Space		DTW (ft)	Associated Shallow Well	Notes
		Depth (ft)	PID (ppm)			
LB-1	7/14/2007	0-4	3.0	12.0	LTW-11	No physical evidence of contamination.
		4-8	16.0			
		8-12	16.5			
		12-16	0.5			
LB-2	7/14/2007	0-4	8.0	11.0	NA	No physical evidence of contamination.
		4-8	22.5			
		8-12	2.9			
		12-16	2.9			
LB-3	7/12/2007	0-4	11.0	11.0	LTW-9	Solvent odor in 4-8' bagged sample.
		4-8	500.0			
		8-12	150.0			
		12-16	15.0			
		44-48	8.8			
LB-4	7/13/2007	0-4	0.0	12.0	NA	No physical evidence of contamination.
		4-8	0.0			
		8-12	0.0			
		12-16	0.8			
LB-5	7/13/2007	0-4	0.0	11.0	LTW-7	No physical evidence of contamination.
		4-8	2.7			
		8-12	0.4			
LB-6	7/13/2007	0-4	0.3	13.0	NA	No physical evidence of contamination.
		4-8	0.0			
		8-12	0.2			
		12-16	0.2			
LB-7	7/11/2007	0-4	0.0	12.0	LTW-1	No physical evidence of contamination.
		4-8	0.1			
		8-12	0.1			
		12-16	0.6			
LB-8	7/11/2007	0-4	0.6	12.5	NA	No physical evidence of contamination.
		4-8	2.5			
		8-12	1.8			
		12-16	1.0			
LB-9	7/12/2007	0-4	0.0	12.0	LTW-3	No physical evidence of contamination.
		4-8	0.0			
		8-12	0.0			
		12-16	0.0			
LB-10	7/12/2007	0-4	0.0	10.5	NA	No physical evidence of contamination.
		4-8	0.0			
		8-12	0.0			
LB-11	7/11/2007	0-4	0.1	11.0	LTW-5	No physical evidence of contamination.
		4-8	0.3			
		8-12	36.2			
		12-16	64.0			
		16-20	10.0			
		20-24	8.5			
LB-12	7/14/2007	0-4	9.5	11.0	NA	Organic odor from 4-12'.
		4-8	279.0			
		8-12	406.0			
		12-16	80.0			
LB-13	7/16/2007	0-4	1.4	11.0	NA	No physical evidence of contamination. Step-out boring from LB-3.
		4-8	24.1			
		8-12	25.3			
LB-14	7/16/2007	0-4	0.0	11.0	NA	PID of 15 ppm at 8-12 sample core. Step-out boring from LB-3.
		4-8	2.5			
		8-12	6.5			

Notes:

- Head space readings obtained using a MineRAE 2000 10.6 eV Photoionization Detector (PID).
- All depth measurements are relative to ground surface.
- DTW measurements estimated at time of drilling.
- NA = Not Applicable

APPENDIX C

Sludge Stabilization Test Results



1359-A Ellsworth Industrial Boulevard • Atlanta, GA 30318 • TEL 404-636-0928 • FAX 404-636-7162

14 November 2007

Mr. Bruce Alleman
Brown and Caldwell
4700 Lakehurst Court
Suite 100
Columbus, Ohio 43016
(614) 923-0858

**Re: Lagoon Solidification / Stabilization Study
KEMRON Project #: SE0229**

Dear Mr. Alleman:

KEMRON Environmental Services, Inc. (KEMRON) is pleased to present Brown and Caldwell with the results of bench-scale testing performed on lagoon sludge materials provided to KEMRON by Brown and Caldwell. The treatability study was performed to evaluate in-situ solidification / stabilization (S/S) techniques capable of stabilizing and improving the materials physical characteristics which would allow the support of a clean soil cap. The following sections of this report include information regarding the protocols followed during each phase of the study and the results of all testing performed.

Untreated Material Characterization

KEMRON received three untreated soil samples from the site labeled "L-1 NE", "L-2 NW", and "L-3 SE". Each site material was received in 5-gallon containers. Upon receipt, the samples were logged into KEMRON's sample tracking database and placed in refrigerated storage at a temperature of 4 degrees Celsius (°C). A copy of the original chain of custody record is presented as **Attachment A**.

Upon authorization to proceed, KEMRON individually homogenized the samples by placing the contents of the containers into a stainless steel mixing pan and gently mixing with stainless steel utensils. For treatability testing, KEMRON typically removes all particles or debris larger than 0.5 inches (in.) in diameter. Once homogenized, the untreated materials were placed back into the original shipping containers and returned to refrigerated storage.

KEMRON performed physical characterization testing of the site materials as outlined in the original scope of work. Geotechnical characterization testing data is used to prepare cost estimates and design specifications with regard to full-scale treatment. The information generated is critical to making sound engineering decisions. The following geotechnical

characterization tests were conducted on the untreated soil in accordance with the referenced test methods:

PARAMETER	METHOD
Particle Size Distribution	ASTM D422
Solid Specific Gravity	ASTM D854
Moisture Content	ASTM D2216
Bulk Density	ASTM D2937 Mod.
Material pH	Method 9045C
Void Ratio / Porosity	Calculated

The results physical characterization testing performed on the untreated site materials are presented in **Table 1**. Complete physical data reports including triplicate results of untreated material characterizations are included as **Attachment B**. The following are summaries of the data presented in **Table 1**. Note that the tables presented in the text of this document are merely summary presentations of data presented in the attachments, and may not include all information included in the Attachments.

TABLE 1					
TESTING PARAMETER	TEST METHOD	UNIT	RESULTS		
			L-1 NE	L-2 NW	L-3 SE
CHEMICAL PROPERTIES					
Material pH	EPA 9045	s.u.	6.07	6.14	6.27
PHYSICAL PROPERTIES					
Unit Weight	ASTM D2937	lb/ft ³	69.0	68.6	68.8
Moisture Content	ASTM D2216	%	318.73	463.98	335.73
Percent Solids	EPA	%	23.88	17.73	22.95
Specific Gravity	ASTM D854	-	1.84	2.14	1.86
Particle Size	ASTM D422				
Gravel		%	0.0	0.0	0.0
Sand		%	1.5	1.2	1.4
Silt		%	87.4	75.8	84.2
Clay		%	11.1	23.0	14.4
Porosity	Calculated	%	85.6	90.9	86.4

Solidification / Stabilization Evaluations

Overview

Upon completion of untreated material characterization testing KEMRON proceeded with solidification / stabilization treatment evaluations. KEMRON performed preliminary stabilization testing in order to evaluate a variety of mixture designs that may be capable of meeting the technical objectives for the project. All preliminary evaluations were performed using untreated material L-2 NW, as it visually seemed to be the "worst-case" of the three untreated materials. Preliminary evaluations were prepared in small cup batches to determine potential setting properties of different reagents and reagent blends. The effectiveness of the mixtures tested was determined through visual observations only. The following is a brief overview of the solidification / stabilization treatment process.

Solidification / Stabilization treatments can be utilized to remediate a wide range of materials and contaminants. Typically binding agents such as Portland cement, slag, kiln dusts, and fly ashes may be blended with soils, sludges and sediments to treat hazardous wastes through mechanisms such as binding excess moisture, macro and micro-encapsulation of contaminants to reduce leaching, hydraulic conductivity reduction, pH adjustment, and chemically altering contaminants of concern.

Treatment

For stabilization treatment, KEMRON developed a total of 9 mixtures for each of the three materials, resulting in a total of twenty-seven mixtures. The mixture designs utilized were based on visual observations performed on the preliminary cup mixtures.

Mixtures were prepared using a bench-scale Hobart-type mixer. The mixer has a 4½ quart stainless steel mixing bowl and "flat beater" type paddles. Treatment utilizing this mixer is intended to simulate, to the extent possible on the bench-scale, potential full-scale remediation options. This approach is routinely utilized to simulate a wide range of potential full-scale remediation approaches, including both in situ and ex situ applications. Note that KEMRON's approach to performing bench-scale testing has been reviewed and is routinely accepted by EPA and full-scale solidification / stabilization contractors.

Treatments in this phase of the study consisted of Type I Portland Cement in combination with Hydrated Lime, Lime Kiln Dust, or Cement Kiln Dust at varying reagent percentages. Historically, KEMRON has observed that organic compounds present in site materials may inhibit the setting of pozzolonic reagents such as those utilized in this study. In order to determine if some of the low strength conditions observed in the preliminary cup mixtures was due to some organic interference, some of the reagent combinations were mixed with potable water to form a paste like consistency prior to mixing with the untreated site materials. These mixtures were prepared by blending the appropriate quantity of reagent with water and then thoroughly mixing with the untreated site material. For clarity, note that the percent reagent addition is based on the total weight of reagent relative to the total weight of the untreated aliquot. For example, in a mixture with a 10 percent (%) addition of Portland cement and 12.5 percent (%) of Hydrated Lime, 10 grams of cement and 12.5 grams of Lime were added for every 100 grams of untreated material. As previously mentioned KEMRON used a Hobart-type

mixer to prepare each mixture. Mixing was conducted at approximately 40 to 60 rotations per minute (rpm), for approximately 60 to 90 seconds, or until visually homogenous.

Immediately following mix development, each treated material was placed into plastic cylindrical curing molds and placed in a humid environment for curing. Throughout the curing process KEMRON evaluated each mixture for potential setting via pocket penetrometer testing. At the 14-day curing interval each treated material was subjected to UCS testing in accordance with ASTM D2166.

TABLE 2				
KEMRON SAMPLE ID	UNTREATED MATERIAL	REAGENT	REAGENT ADDITION (%)	WATER ADDITION (%)
SE0229-001	L-1 NE	Type I Portland Cement / Hydrated Lime	7.5 / 10	0
SE0229-002	L-1 NE	Cement / H-lime	10 / 12.5	0
SE0229-003	L-1 NE	Cement / H-lime	15 / 10	15.0
SE0229-004	L-1 NE	Cement / Lime Kiln Dust	7.5 / 20	0
SE0229-005	L-1 NE	Cement / Lime Kiln Dust	10 / 20	0
SE0229-006	L-1 NE	Cement / Lime Kiln Dust	15 / 30	15.8
SE0229-007	L-1 NE	Cement / Cement Kiln Dust	7.5 / 20	0
SE0229-008	L-1 NE	Cement / Cement Kiln Dust	10 / 20	0
SE0229-009	L-1 NE	Cement / Cement Kiln Dust	15 / 30	18.3
SE0229-010	L-2 NW	Type I Portland Cement / Hydrated Lime	7.5 / 10	0
SE0229-011	L-2 NW	Cement / H-lime	10 / 12.5	0
SE0229-012	L-2 NW	Cement / H-lime	15 / 10	16.7
SE0229-013	L-2 NW	Cement / Lime Kiln Dust	7.5 / 20	0
SE0229-014	L-2 NW	Cement / Lime Kiln Dust	10 / 20	0
SE0229-015	L-2 NW	Cement / Lime Kiln Dust	15 / 30	15.3
SE0229-016	L-2 NW	Cement / Cement Kiln Dust	7.5 / 20	0
SE0229-017	L-2 NW	Cement / Cement Kiln Dust	10 / 20	0
SE0229-018	L-2 NW	Cement / Cement Kiln Dust	15 / 30	21.9
SE0229-019	L-3 SE	Type I Portland Cement / Hydrated Lime	7.5 / 10	0
SE0229-020	L-3 SE	Cement / H-lime	10 / 12.5	0
SE0229-021	L-3 SE	Cement / H-lime	15 / 10	16.3
SE0229-022	L-3 SE	Cement / Lime Kiln Dust	7.5 / 20	0
SE0229-023	L-3 SE	Cement / Lime Kiln Dust	10 / 20	0
SE0229-024	L-3 SE	Cement / Lime Kiln Dust	15 / 30	17.6
SE0229-025	L-3 SE	Cement / Cement Kiln Dust	7.5 / 20	0
SE0229-026	L-3 SE	Cement / Cement Kiln Dust	10 / 20	0
SE0229-027	L-3 SE	Cement / Cement Kiln Dust	15 / 30	21.0

Treatment Evaluations

Review of Strength Data

The results of penetrometer and UCS testing performed on the treated mixtures are presented in **Tables 3 and 4**. Review of the penetrometer data indicated that materials treated with Portland cement and LKD exhibited the greatest strength increase at the 14 cure interval. In general, penetrometer results strongly followed UCS results within any given set of mixtures. That is in treatments using cement and lime kiln dust increasing penetrometer results were associated with increasing UCS results. However when developing a correlation between potential UCS strengths and penetrometer strengths, the bench-scale data indicates that penetrometer strengths can only be loosely correlated to potential UCS strengths. For instance materials exhibiting a penetrometer strength of 1.0 ton per square foot (TSF) at the 14 day cure had UCS values ranging from 14.5 to 24.2 psi. Mixtures exhibiting penetrometer strengths ranging from 2.0 to 3.0 TSF had UCS values of approximately 27 psi. This data indicates that especially at lower penetrometer readings a significant range of UCS values may be realized.

At 14 days of curing, each treated specimen was subjected to Unconfined Compressive Strength (UCS) testing in accordance with the American Society of Testing and Materials (ASTM) method D2166. While no specific strength criteria were outlined for this project, KEMRON's experience is that as little 12 to 15 psi is often sufficient to support standard construction equipment as well as a soil cap. The results of UCS testing are presented in **Table 4**. This table includes KEMRON's sample identification number, the cure time at testing, reagent addition percent (%) and the UCS results. The following is a summary of **Table 4**:

TABLE 4						
KEMRON SAMPLE No.	UNTREATED MATERIAL TYPE	Cure Time (days)	UNCONFINED COMPRESSIVE STRENGTH			
			Moisture Content (%)	Bulk Density (lbs/ft ³)	Dry Density (lbs/ft ³)	UCS (lbs/in ²)
0229-001	L-1 NE	14	151.66	76.4	30.4	15.0
0229-002	L-1 NE	14	144.2	77.3	31.6	21.7
0229-003	L-1 NE	14	158.54	76	29.4	24.1
0229-004	L-1 NE	14	128.34	80.4	35.2	27.1
0229-005	L-1 NE	14	118.38	81.1	37.2	37.3
0229-006	L-1 NE	14	109.42	83.2	39.7	42.5
0229-007	L-1 NE	14	NA	NA	NA	NA
0229-008	L-1 NE	14	127.14	81.1	35.7	17.3
0229-009	L-1 NE	14	128.3	81.8	35.8	26.4
0229-010	L-2 NW	14	NA	NA	NA	NA
0229-011	L-2 NW	14	180.2	77.1	27.5	7.5
0229-012	L-2 NW	14	197.55	76.3	25.6	8.2
0229-013	L-2 NW	14	153	80.4	31.8	10.2
0229-014	L-2 NW	14	143.58	80.6	33.1	16.4
0229-015	L-2 NW	14	123.16	83.7	37.5	19.8

TABLE 4 Continued						
KEMRON SAMPLE No.	UNTREATED MATERIAL TYPE	Cure Time (days)	UNCONFINED COMPRESSIVE STRENGTH			
			Moisture Content (%)	Bulk Density (lbs/ft ³)	Dry Density (lbs/ft ³)	UCS (lbs/in ²)
0229-016	L-2 NW	14	NA	NA	NA	NA
0229-017	L-2 NW	14	153.33	79.8	31.5	10.6
0229-018	L-2 NW	14	145.01	81.3	33.2	14.5
0229-019	L-3 SE	14	NA	NA	NA	NA
0229-020	L-3 SE	14	147.89	77.1	31.1	24.2
0229-021	L-3 SE	14	165.42	76.2	28.7	15.1
0229-022	L-3 SE	14	133.4	80.2	34.3	27.4
0229-023	L-3 SE	14	124.6	81.5	36.3	39.3
0229-024	L-3 SE	14	119.5	82.3	37.5	45.1
0229-025	L-3 SE	14	NA	NA	NA	NA
0229-026	L-3 SE	14	138.5	80.9	33.9	7.2
0229-027	L-3 SE	14	127.1	80.9	35.6	27.0

NA indicates that the sample was not tested due to insufficient cohesion. That is that the sample did not exhibit enough strength to stand under its own weight.

Note that no significant increase in strength was observed with the water additions to the different mixture designs. The data demonstrates that the addition of Portland cement and Lime Kiln Dust resulted in the greatest increase in strength of all reagent blends at the 14 day cure interval. Mixtures involving untreated sample "L-2 NW" had overall lower strength results when compared with other materials. KEMRON believes that this is primarily due to the higher liquid, moisture, content this material exhibited compared to "L-1 NE" and "L-3 SE".

KEMRON and Brown and Caldwell selected 6 mixture designs, two for each untreated material for additional geotechnical testing. These mixtures were selected based on the results of UCS testing. Specifically, the mixtures evaluated included mixture designs utilizing Type I Portland cement in combination with lime kiln dust at addition rates of 7.5 and 20% respectively, and 10 and 20% respectively. Mixtures, 004, 005, 022 and 023 exhibited UCS values of approximately 27 psi at the lower cement addition rate and from 37 to 39 psi at the higher addition. Mixtures 013 and 014 had strengths of 10.2 psi at the lower cement addition and 16.4 psi at the higher rate. This data again indicates that the higher liquid content of the L-2 NW material may have reduced the effectiveness of treatment.

Following 28 days of curing, each candidate mixture was subjected to one-dimensional consolidation testing in accordance with ASTM D2435. Based on information provided to KEMRON by Brown and Caldwell a standard loading schedule with a maximum of 4 tons per square foot (TSF) was used for testing. Additionally, this material was not inundated with water due to its intended placement above the existing site water table. Complete data reports for one-dimensional consolidation testing are included in the attachments.

Because KEMRON was not contracted for geotechnical engineering services no interpretation of the consolidation data has been included. However, cursory review of the data indicates that at a load of 0.5 TSF the treated materials exhibited percent strains ranging from approximately 1.3 to 4, which is a significant improvement from the 32 to 53% seen in the untreated materials.

Conclusions

Based on the results of testing it appears that site materials L-1 and L-3 are very similar in physical characteristics and treatability. Specifically treatment of the site materials using a combination of Type I Portland cement and lime kiln dust, at a minimum cement addition rate of 7.5% and a minimum LKD addition rate of 20%, resulted in strength values greater than 25 psi for both site materials L-1 and L-3. Additionally, strength comparisons of other mixtures developed using these two site materials indicate that similar results were observed when using similar reagent addition rates. Testing performed on site material L-2 indicates that significantly lower strengths were recorded compared to the same mixtures performed on the other two site samples. KEMRON feels that the lower strength results are predominantly due to the higher liquid content exhibited in sample L-2. More beneficial treatment results may be achieved if additional liquid is removed from site material L-2.

KEMRON Environmental Services, Inc. is pleased to present Brown and Caldwell with this final letter report for the Lagoon Solidification / Stabilization treatability study. If you have any questions, or require additional information, please contact either of the undersigned.

Sincerely,

KEMRON ENVIRONMENTAL SERVICES, INC.



Mark Clark
Applied Technologies Group
Project Manager
mclark@KEMRON.com



Kelly Clemons
Applied Technologies Group
Department Manager
kclemons@KEMRON.com

Attachments

TABLES

**BROWN AND CALDWELL
LAGOON STABILIZATION STUDY**

**TABLE 1
UNTREATED MATERIAL CHARACTERIZATION**

TESTING PARAMETER	TEST METHOD	UNIT	RESULTS		
			L-1 NE	L-2 NW	L-3 SE
CHEMICAL PROPERTIES					
Material pH	EPA 9045	s.u.	6.07	6.14	6.27
PHYSICAL PROPERTIES					
Unit Weight	ASTM D2937	lb/ft ³	69.0	68.6	68.8
Moisture Content	ASTM D2216	%	318.73	463.98	335.73
Percent Solids	EPA	%	23.88	17.73	22.95
Specific Gravity	ASTM D854	-	1.84	2.14	1.86
Particle Size	ASTM D422				
Gravel		%	0.0	0.0	0.0
Sand		%	1.5	1.2	1.4
Silt		%	87.4	75.8	84.2
Clay		%	11.1	23.0	14.4
Porosity	Calculated	%	85.6	90.9	86.4

s.u. - standard unit

**BROWN AND CALDWELL
LAGOON STABILIZATION STUDY**

**TABLE 2
MIXTURE DESIGNS**

KEMRON SAMPLE ID	UNTREATED MATERIAL	REAGENT	REAGENT ADDITION (%)	WATER ADDITION (%)
SE0229-001	L-1 NE	Type I Portland Cement / Hydrated Lime	7.5 / 10	0
SE0229-002	L-1 NE	Cement / H-lime	10 / 12.5	0
SE0229-003	L-1 NE	Cement / H-lime	15 / 10	15.0
SE0229-004	L-1 NE	Cement / Lime Kiln Dust	7.5 / 20	0
SE0229-005	L-1 NE	Cement / Lime Kiln Dust	10 / 20	0
SE0229-006	L-1 NE	Cement / Lime Kiln Dust	15 / 30	15.8
SE0229-007	L-1 NE	Cement / Cement Kiln Dust	7.5 / 20	0
SE0229-008	L-1 NE	Cement / Cement Kiln Dust	10 / 20	0
SE0229-009	L-1 NE	Cement / Cement Kiln Dust	15 / 30	18.3
SE0229-010	L-2 NW	Type I Portland Cement / Hydrated Lime	7.5 / 10	0
SE0229-011	L-2 NW	Cement / H-lime	10 / 12.5	0
SE0229-012	L-2 NW	Cement / H-lime	15 / 10	16.7
SE0229-013	L-2 NW	Cement / Lime Kiln Dust	7.5 / 20	0
SE0229-014	L-2 NW	Cement / Lime Kiln Dust	10 / 20	0
SE0229-015	L-2 NW	Cement / Lime Kiln Dust	15 / 30	15.3
SE0229-016	L-2 NW	Cement / Cement Kiln Dust	7.5 / 20	0
SE0229-017	L-2 NW	Cement / Cement Kiln Dust	10 / 20	0
SE0229-018	L-2 NW	Cement / Cement Kiln Dust	15 / 30	21.9
SE0229-019	L-3 SE	Type I Portland Cement / Hydrated Lime	7.5 / 10	0
SE0229-020	L-3 SE	Cement / H-lime	10 / 12.5	0
SE0229-021	L-3 SE	Cement / H-lime	15 / 10	16.3
SE0229-022	L-3 SE	Cement / Lime Kiln Dust	7.5 / 20	0
SE0229-023	L-3 SE	Cement / Lime Kiln Dust	10 / 20	0
SE0229-024	L-3 SE	Cement / Lime Kiln Dust	15 / 30	17.6
SE0229-025	L-3 SE	Cement / Cement Kiln Dust	7.5 / 20	0
SE0229-026	L-3 SE	Cement / Cement Kiln Dust	10 / 20	0
SE0229-027	L-3 SE	Cement / Cement Kiln Dust	15 / 30	21.0

Brown and Caldwell
LAGOON STABILIZATION STUDY

TABLE 3
Mixture Development and Unconfined Compressive Strength Testing Results ASTM D2166

KEMRON SAMPLE No.	UNTREATED MATERIAL TYPE	REAGENT TYPE	Reagent Addition (%)	Water Addition (%)	Cure Time (days)	UNCONFINED COMPRESSIVE STRENGTH			
						Moisture Content (%)	Bulk Density (lbs/ft ³)	Dry Density (lbs/ft ³)	UCS (lbs/in ²)
0229-001	L-1 NE	Portland Cement / Hydrated Lime	7.5 / 10	0.0	14	151.66	76.4	30.4	15.0
0229-002	L-1 NE	Portland Cement / Hydrated Lime	10 / 12.5	0.0	14	144.2	77.3	31.6	21.7
0229-003	L-1 NE	Portland Cement / Hydrated Lime	15 / 10	15.0	14	158.54	76	29.4	24.1
0229-004	L-1 NE	Portland Cement / Lime Kiln Dust	7.5 / 20	0.0	14	128.34	80.4	35.2	27.1
0229-005	L-1 NE	Portland Cement / Lime Kiln Dust	10.0 / 20	0.0	14	118.38	81.1	37.2	37.3
0229-006	L-1 NE	Portland Cement / Lime Kiln Dust	15 / 30	15.8	14	109.42	83.2	39.7	42.5
0229-007	L-1 NE	Portland Cement / Cement Kiln Dust	7.5 / 20	0.0	14	*	*	*	*
0229-008	L-1 NE	Portland Cement / Cement Kiln Dust	10.0 / 20	0.0	14	127.14	81.1	35.7	17.3
0229-009	L-1 NE	Portland Cement / Cement Kiln Dust	15 / 30	18.3	14	128.3	81.8	35.8	26.4
0229-010	L-2 NW	Portland Cement / Hydrated Lime	7.5 / 10	0.0	14	*	*	*	*
0229-011	L-2 NW	Portland Cement / Hydrated Lime	10 / 12.5	0.0	14	180.2	77.1	27.5	7.5
0229-012	L-2 NW	Portland Cement / Hydrated Lime	15 / 10	16.7	14	197.55	76.3	25.6	8.2
0229-013	L-2 NW	Portland Cement / Lime Kiln Dust	7.5 / 20	0.0	14	153	80.4	31.8	10.2
0229-014	L-2 NW	Portland Cement / Lime Kiln Dust	10.0 / 20	0.0	14	143.58	80.6	33.1	16.4
0229-015	L-2 NW	Portland Cement / Lime Kiln Dust	15 / 30	15.3	14	123.16	83.7	37.5	19.8
0229-016	L-2 NW	Portland Cement / Cement Kiln Dust	7.5 / 20	0.0	14	*	*	*	*
0229-017	L-2 NW	Portland Cement / Cement Kiln Dust	10.0 / 20	0.0	14	153.33	79.8	31.5	10.6
0229-018	L-2 NW	Portland Cement / Cement Kiln Dust	15 / 30	21.9	14	145.01	81.3	33.2	14.5
0229-019	L-3 SE	Portland Cement / Hydrated Lime	7.5 / 10	0.0	14	*	*	*	*
0229-020	L-3 SE	Portland Cement / Hydrated Lime	10 / 12.5	0.0	14	147.89	77.1	31.1	24.2
0229-021	L-3 SE	Portland Cement / Hydrated Lime	15 / 10	16.3	14	165.42	76.2	28.7	15.1
0229-022	L-3 SE	Portland Cement / Lime Kiln Dust	7.5 / 20	0.0	14	133.4	80.2	34.3	27.4
0229-023	L-3 SE	Portland Cement / Lime Kiln Dust	10.0 / 20	0.0	14	124.6	81.5	36.3	39.3
0229-024	L-3 SE	Portland Cement / Lime Kiln Dust	15 / 30	17.6	14	119.5	82.3	37.5	45.1
0229-025	L-3 SE	Portland Cement / Cement Kiln Dust	7.5 / 20	0.0	14	*	*	*	*
0229-026	L-3 SE	Portland Cement / Cement Kiln Dust	10.0 / 20	0.0	14	138.5	80.9	33.9	7.2
0229-027	L-3 SE	Portland Cement / Cement Kiln Dust	15 / 30	21.0	14	127.1	80.9	35.6	27.0

* Samples lacked sufficient cohesion to test.

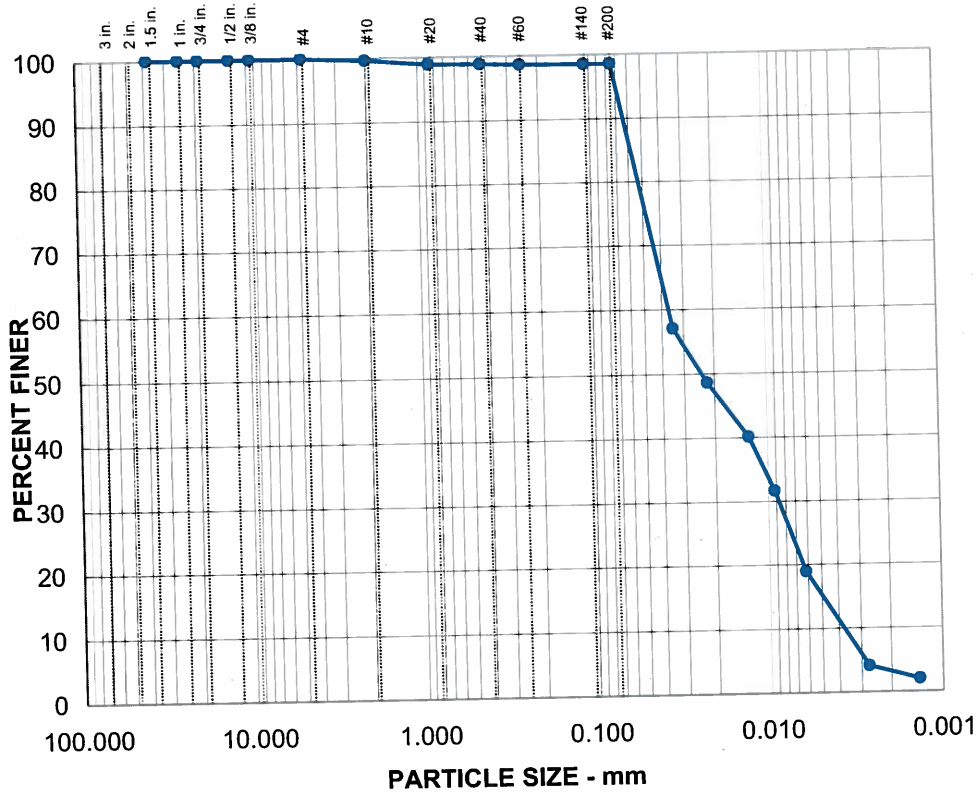
APPENDIX A

CHAIN OF CUSTODY

APPENDIX B

LABORATORY AND PHYSICAL PROPERTY DATA

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.5	83.2	15.3

SAMPLE INFORMATION	
Project Name:	Brown and Caldwell
Project Number:	SE-0229
Sample ID:	L-1 NE
Sample Description:	Silty Clay
Testing Date:	09/07/07

Kemron
ENVIRONMENTAL SERVICES

SAMPLE CLASSIFICATION	
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION:	
Silty Clay	

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
SAMPLE No.: L-1 NE
SAMPLE DESCRIPT: Silty Clay
TESTING DATE: 09/07/07
TESTED BY: RRB
TRACKING CODE: 4535 GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	252.63 g
WT WET SOIL + TARE	353.54 g
WT DRY SOIL + TARE	275.77 g
WT WATER, Ww	77.77 g
WT DRY SOIL, Ws	23.14 g
ASTM MOISTURE	336.08 %
EPA MOISTURE	77.07 %

SIEVE NUMBER	PERCENT PASSING
1.5	100.0 %
1.0	100.0 %
0.75	100.0 %
0.5	100.0 %
0.375	100.0 %
#4	100.0 %
#10	99.7 %
#20	98.9 %
#40	98.7 %
#60	98.6 %
#140	98.5 %
#200	98.5 %

HYDROMETER ANALYSIS	
HYDROMETER No.	1, 2, & 3
Wt OF DRY SOIL, Ws	22.80
DATE TESTING INITIATED	10/12/07
TIME TESTING INITIATED	10:33:00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	19.0	13.5	0.0343	57.0
5	17.0	11.5	0.0220	48.5
15	15.0	9.5	0.0128	40.1
30	13.0	7.5	0.0092	31.6
70	10.0	4.5	0.0061	18.9
376	6.5	1.0	0.0027	4.1
1470	6.0	0.5	0.0014	1.9

Kemron
ENVIRONMENTAL SERVICES

SOLID SPECIFIC GRAVITY

ASTM D 854
DATA SHEET

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
TESTING DATE: 10/12/2007
TESTED BY: RRB
TRACKING CODE: 4535
SAMPLE NO: L-1 NE

SOLID SPECIFIC GRAVITY	
1. SAMPLE NUMBER	L-1 NE
2. FLASK NUMBER	1
3. TEMPERATURE	20.0 °C
4. WT. FLASK & WATER	173.16 g
5. WT. WATER, FLASK & SOIL	203.41 g
6. WT OF SOIL	30.25 g
7. CALIBRATION WATER & FLASK	347.95 g
8. DEAIRED SAMPLE	361.72 g
9. SPECIFIC GRAVITY	1.84
10. CORRECTION FACTOR K	1.0000
11. Gs @ 20 °C	1.84

MOISTURE CONTENT DETERMINATION

REPORT FORM

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
SAMPLE No.: L-1 NE
TESTING DATE: 7-Sep-07
TESTED BY: SEM
TRACKING CODE: 4535_MC

MOISTURE CONTENT (Dry & Wet Basis)			
1. MOISTURE TIN NO.	A	B	C
2. WT MOISTURE TIN (tare weight)	66.99 g	70.24 g	65.47 g
3. WT WET SOIL + TARE	151.69 g	165.60 g	160.25 g
4. WT DRY SOIL + TARE	87.38 g	92.97 g	87.97 g
5. WT WATER, W _w	64.31 g	72.63 g	72.28 g
6. WT DRY SOIL, W _s	20.39 g	22.73 g	22.50 g
7. ASTM MOISTURE CONTENT	315.40 %	319.53 %	321.24 %
8. PERCENT SOLIDS	24.07 %	23.84 %	23.74 %
9. AVERAGE ASTM MOISTURE CONTENT	318.73 %		
10. AVERAGE PERCENT SOLIDS	23.88 %		

MATERIAL pH

EPA METHOD 9045
DATA SHEET

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
TESTING DATE: 9/7/2007
TESTED BY: RRB
TRACKING CODE: 4535_pH

KEMRON SAMPLE No.	MATERIAL pH
1. L-1 NE	6.12
2. L-1 NE Duplicate	6.08
3. L-1 NE Triplicate	6.00
4.	
5.	
6.	
7.	
8.	
9.	
10.	
Average:	6.07

TOTAL POROSITY

PROJECT:	<u>Brown and Caldwell</u>
PROJECT No.:	<u>SE-0229</u>
TESTING DATE:	<u>11/5/2007</u>
TRACKING CODE:	<u>4535 TP</u>

Total porosity and Pore Volume Calculation	
SAMPLE No.	L-1 NE
1. Bulk Density	69.0 lbs/ft ³
2. Moisture Content	318.7 %
3. Specific Gravity	1.84 -
4. Dry Density	16.5 lbs/ft ³
6. Weight of Solids ₍₁₎	0.2641 g
7. Volume of Solids ₍₁₎	0.1435 cm ³
8. Volume of Voids ₍₁₎	0.8565 cm ³
9. Total Porosity (e)	85.6 %

₁ Calculated for 1 cubic centimeter

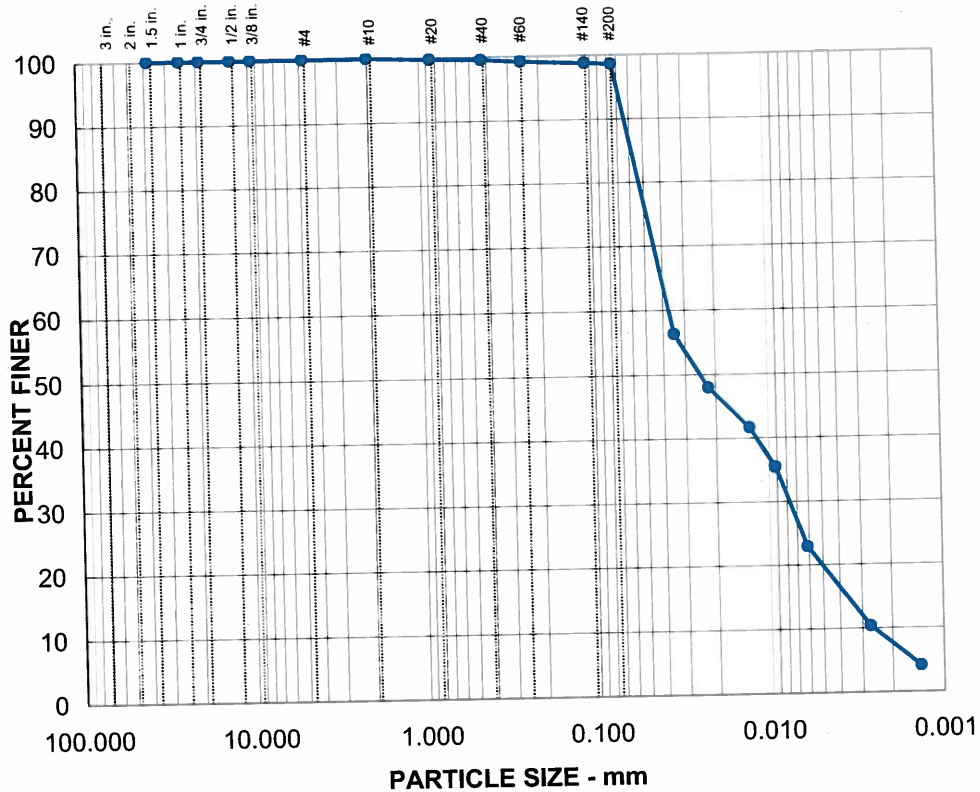
UNIT WEIGHT DETERMINATION

DATA SHEET

PROJECT: Brown and Caldwell
 PROJECT No.: SE-0229
 SAMPLE No.: L-1 NE
 TESTING DATE: 9/7/2007
 TESTED BY: RRB
 TRACKING CODE: 4535 UW

UNIT WEIGHT (DENSITY)			
1. SAMPLE NO.	A	B	C
2. WT OF MOLD (tare weight)	22.52 g	22.52 g	22.52 g
3. WT OF MOLD + SOIL	249.29 g	251.34 g	250.05 g
4. WT OF WET SOIL, W	226.77 g	228.82 g	227.53 g
5. DIAMETER OF SPECIMEN, D	2.00 in	2.00 in	2.00 in
6. HEIGHT OF SPECIMEN, H	4.00 in	4.00 in	4.00 in
7. VOLUME OF SPECIMEN	12.57 in ³	12.57 in ³	12.57 in ³
8. BULK UNIT WEIGHT	68.7 pcf	69.4 pcf	69.0 pcf
9. BULK SPECIFIC GRAVITY	1.1	1.1	1.1
10. AVERAGE BULK UNIT WEIGHT	69.0 pcf		
11. AVERAGE BULK SPECIFIC GRAVITY	1.1		

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.4	78.8	19.8

SAMPLE INFORMATION	
Project Name:	Brown and Caldwell
Project Number:	SE-0229
Sample ID:	L-3 SE
Sample Description:	Silty Clay
Testing Date:	09/07/07

KEMRON
ENVIRONMENTAL SERVICES

SAMPLE CLASSIFICATION	
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION:	
Silty Clay	

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
SAMPLE No.: L-3 SE
SAMPLE DESCRIPT: Silty Clay
TESTING DATE: 09/07/07
TESTED BY: RRB
TRACKING CODE: 4536 GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	232.65 g
WT WET SOIL + TARE	334.56 g
WT DRY SOIL + TARE	256.11 g
WT WATER, W _w	78.45 g
WT DRY SOIL, W _s	23.46 g
ASTM MOISTURE	334.40 %
EPA MOISTURE	76.98 %

SIEVE NUMBER	PERCENT PASSING
1.5	100.0 %
1.0	100.0 %
0.75	100.0 %
0.5	100.0 %
0.375	100.0 %
#4	100.0 %
#10	100.0 %
#20	99.7 %
#40	99.5 %
#60	99.2 %
#140	98.8 %
#200	98.6 %

HYDROMETER ANALYSIS	
HYDROMETER No.	4.5, & 6
Wt OF DRY SOIL, W _s	23.12
DATE TESTING INITIATED	10/12/07
TIME TESTING INITIATED	10:30:00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	19.0	13.5	0.0343	56.2
5	17.0	11.5	0.0220	47.9
15	15.5	10.0	0.0128	41.6
30	14.0	8.5	0.0091	35.3
70	11.0	5.5	0.0061	22.8
377	8.0	2.5	0.0027	10.3
1470	6.5	1.0	0.0014	4.0

Kemron
ENVIRONMENTAL SERVICES

SOLID SPECIFIC GRAVITY

ASTM D 854
DATA SHEET

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
TESTING DATE: 10/12/2007
TESTED BY: RRB
TRACKING CODE: 4536
SAMPLE NO: L-3 SE

SOLID SPECIFIC GRAVITY	
1. SAMPLE NUMBER	L-3 SE
2. FLASK NUMBER	2
3. TEMPERATURE	21.0 °C
4. WT. FLASK & WATER	168.95 g
5. WT. WATER, FLASK & SOIL	208.28 g
6. WT OF SOIL	39.33 g
7. CALIBRATION WATER & FLASK	351.42 g
8. DEAIRED SAMPLE	369.59 g
9. SPECIFIC GRAVITY	1.86
10. CORRECTION FACTOR K	0.9998
11. Gs @ 20 °C	1.86

MOISTURE CONTENT DETERMINATION

REPORT FORM

PROJECT: _____ Brown and Caldwell
PROJECT No.: _____ SE-0229
SAMPLE No.: _____ L-3 SE
TESTING DATE: _____ 7-Sep-07
TESTED BY: _____ SEM
TRACKING CODE: _____ 4536_MC

MOISTURE CONTENT (Dry & Wet Basis)			
1. MOISTURE TIN NO.	A	B	C
2. WT MOISTURE TIN (tare weight)	86.75 g	70.86 g	69.20 g
3. WT WET SOIL + TARE	146.84 g	153.22 g	162.22 g
4. WT DRY SOIL + TARE	100.59 g	89.79 g	90.44 g
5. WT WATER, W _w	46.25 g	63.43 g	71.78 g
6. WT DRY SOIL, W _s	13.84 g	18.93 g	21.24 g
7. ASTM MOISTURE CONTENT	334.18 %	335.08 %	337.95 %
8. PERCENT SOLIDS	23.03 %	22.98 %	22.83 %
9. AVERAGE ASTM MOISTURE CONTENT	335.73 %		
10. AVERAGE PERCENT SOLIDS	22.95 %		

MATERIAL pH

EPA METHOD 9045
DATA SHEET

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
TESTING DATE: 9/7/2007
TESTED BY: RRB
TRACKING CODE: 4536_pH

KEMRON SAMPLE No.	MATERIAL pH
1. L-3 SE	6.22
2. L-3 SE Duplicate	6.23
3. L-3 SE Triplicate	6.35
4.	
5.	
6.	
7.	
8.	
9.	
10.	
Average:	6.27

TOTAL POROSITY

PROJECT:	<u>Brown and Caldwell</u>
PROJECT No.:	<u>SE-0229</u>
TESTING DATE:	<u>11/5/2007</u>
TRACKING CODE:	<u>4536_TP</u>

Total porosity and Pore Volume Calculation	
SAMPLE No.	L-3 SE
1. Bulk Density	68.8 lbs/ft ³
2. Moisture Content	335.7 %
3. Specific Gravity	1.86 -
4. Dry Density	15.8 lbs/ft ³
6. Weight of Solids ₍₁₎	0.2530 g
7. Volume of Solids ₍₁₎	0.1360 cm ³
8. Volume of Voids ₍₁₎	0.8640 cm ³
9. Total Porosity (e)	86.4 %

₁ Calculated for 1 cubic centimeter

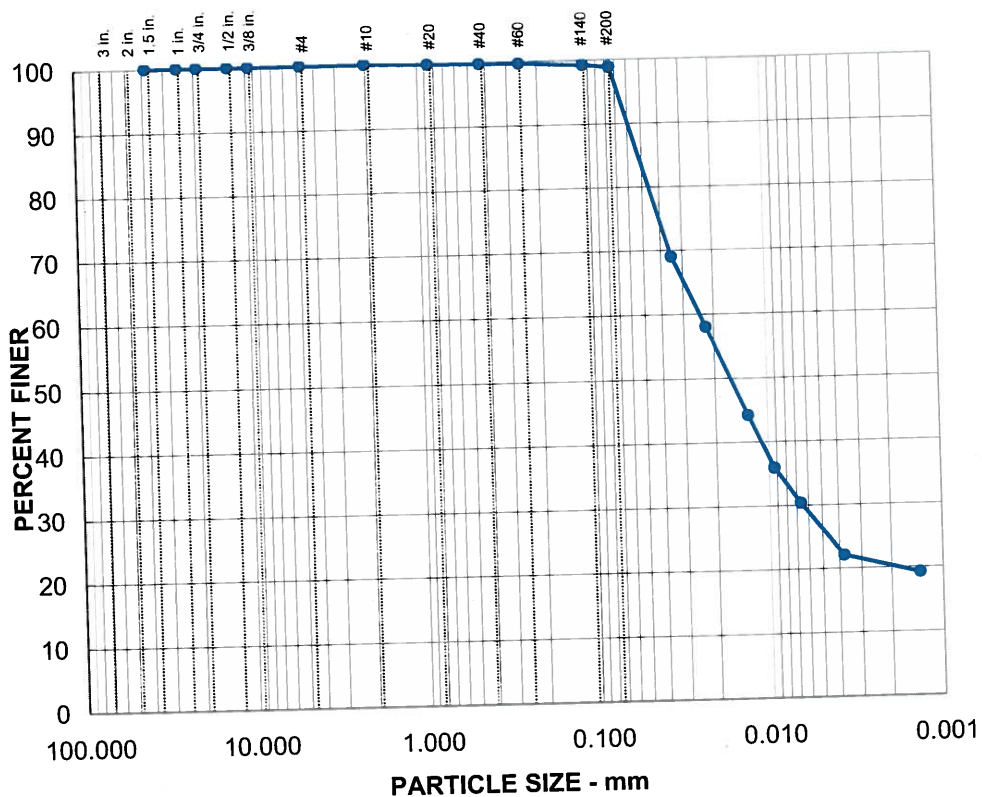
UNIT WEIGHT DETERMINATION

DATA SHEET

PROJECT: Brown and Caldwell
 PROJECT No.: SE-0229
 SAMPLE No.: L-3 SE
 TESTING DATE: 9/7/2007
 TESTED BY: RRB
 TRACKING CODE: 4536 UW

UNIT WEIGHT (DENSITY)			
1. SAMPLE NO.	A	B	C
2. WT OF MOLD (tare weight)	22.50 g	22.50 g	22.50 g
3. WT OF MOLD + SOIL	249.25 g	249.50 g	249.39 g
4. WT OF WET SOIL, W	226.75 g	227.00 g	226.89 g
5. DIAMETER OF SPECIMEN, D	2.00 in	2.00 in	2.00 in
6. HEIGHT OF SPECIMEN, H	4.00 in	4.00 in	4.00 in
7. VOLUME OF SPECIMEN	12.57 in ³	12.57 in ³	12.57 in ³
8. BULK UNIT WEIGHT	68.7 pcf	68.8 pcf	68.8 pcf
9. BULK SPECIFIC GRAVITY	1.1	1.1	1.1
10. AVERAGE BULK UNIT WEIGHT	68.8 pcf		
11. AVERAGE BULK SPECIFIC GRAVITY	1.1		

PARTICLE SIZE DISTRIBUTION TEST REPORT



% GRAVEL	% SAND	% SILT	% CLAY
0.0	1.2	72.5	26.3

SAMPLE INFORMATION	
Project Name:	Brown & Caldwell
Project Number:	SE-0229
Sample ID:	L-2 NW
Sample Description:	Silty Clay
Testing Date:	09/06/07

KEMRON
ENVIRONMENTAL SERVICES

SAMPLE CLASSIFICATION	
Liquid Limit:	
Plastic Limit:	
Plasticity Index:	
USCS Classification	
Classification	
AASHTO Classification	
Classification	
Group Index	
DESCRIPTION:	
Silty Clay	

PARTICLE SIZE DISTRIBUTION DATA REPORT

REPORT FORM
ASTM D422

PROJECT: Brown & Caldwell
PROJECT No.: SE-0229
SAMPLE No.: L-2 NW
SAMPLE DESCRIPT: Silty Clay
TESTING DATE: 09/06/07
TESTED BY: SEM
TRACKING CODE: 4539 GR

MOISTURE CONTENT (DRY AND WET BASIS)	
TARE WEIGHT	234.40 g
WT WET SOIL + TARE	334.43 g
WT DRY SOIL + TARE	252.09 g
WT WATER, Ww	82.34 g
WT DRY SOIL, Ws	17.69 g
ASTM MOISTURE	465.46 %
EPA MOISTURE	82.32 %

SIEVE NUMBER	PERCENT PASSING
1.5	100.0 %
1.0	100.0 %
0.75	100.0 %
0.5	100.0 %
0.375	100.0 %
#4	100.0 %
#10	100.0 %
#20	99.8 %
#40	99.7 %
#60	99.6 %
#140	99.2 %
#200	98.8 %

HYDROMETER ANALYSIS	
HYDROMETER No.	8 & 9
WT OF DRY SOIL, Ws	17.47
DATE TESTING INITIATED	10/29/07
TIME TESTING INITIATED	10:36:00 AM

ELAPSED TIME (minutes)	ACTUAL READING	CORRECTED READING	DIAMETER (mm)	PERCENT FINER (%)
2	18.0	12.5	0.0345	69.0
5	16.0	10.5	0.0221	57.9
15	13.5	8.0	0.0130	44.1
30	12.0	6.5	0.0092	35.8
60	11.0	5.5	0.0066	30.2
190	9.5	4.0	0.0037	21.9
1450	9.0	3.5	0.0014	19.2

Kemron
ENVIRONMENTAL SERVICES

SOLID SPECIFIC GRAVITY

ASTM D 854
DATA SHEET

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
TESTING DATE: 10/12/2007
TESTED BY: RRB
TRACKING CODE: 4539
SAMPLE NO: L-2 NW

SOLID SPECIFIC GRAVITY	
1. SAMPLE NUMBER	L-2 NW
2. FLASK NUMBER	1
3. TEMPERATURE	21.0 °C
4. WT. FLASK & WATER	174.02 g
5. WT. WATER, FLASK & SOIL	214.09 g
6. WT OF SOIL	40.07 g
7. CALIBRATION WATER & FLASK	347.89 g
8. DEAIRED SAMPLE	369.28 g
9. SPECIFIC GRAVITY	2.15
10. CORRECTION FACTOR K	0.9998
11. Gs @ 20 °C	2.14

MOISTURE CONTENT DETERMINATION

REPORT FORM

PROJECT: _____ Brown and Caldwell
 PROJECT No.: _____ SE-0229
 SAMPLE No.: _____ L-2 NW
 TESTING DATE: _____ 7-Sep-07
 TESTED BY: _____ SEM
 TRACKING CODE: _____ 4539 MC

MOISTURE CONTENT (Dry & Wet Basis)			
1. MOISTURE TIN NO.	A	B	C
2. WT MOISTURE TIN (tare weight)	65.00 g	68.91 g	67.04 g
3. WT WET SOIL + TARE	127.56 g	143.25 g	147.07 g
4. WT DRY SOIL + TARE	76.12 g	82.05 g	81.24 g
5. WT WATER, Ww	51.44 g	61.20 g	65.83 g
6. WT DRY SOIL, Ws	11.12 g	13.14 g	14.20 g
7. ASTM MOISTURE CONTENT	462.59 %	465.75 %	463.59 %
8. PERCENT SOLIDS	17.77 %	17.68 %	17.74 %
9. AVERAGE ASTM MOISTURE CONTENT	463.98 %		
10. AVERAGE PERCENT SOLIDS	17.73 %		

MOISTURE CONTENT DETERMINATION

REPORT FORM

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
SAMPLE No.: L-2 NW
TESTING DATE: 7-Sep-07
TESTED BY: SEM
TRACKING CODE: 4539_MC

MOISTURE CONTENT (Dry & Wet Basis)			
1. MOISTURE TIN NO.	A	B	C
2. WT MOISTURE TIN (tare weight)	65.00 g	68.91 g	67.04 g
3. WT WET SOIL + TARE	127.56 g	143.25 g	147.07 g
4. WT DRY SOIL + TARE	76.12 g	82.05 g	81.24 g
5. WT WATER, W _w	51.44 g	61.20 g	65.83 g
6. WT DRY SOIL, W _s	11.12 g	13.14 g	14.20 g
7. ASTM MOISTURE CONTENT	462.59 %	465.75 %	463.59 %
8. PERCENT SOLIDS	17.77 %	17.68 %	17.74 %
9. AVERAGE ASTM MOISTURE CONTENT	463.98 %		
10. AVERAGE PERCENT SOLIDS	17.73 %		

MATERIAL pH

EPA METHOD 9045
DATA SHEET

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
TESTING DATE: 9/7/2007
TESTED BY: RRB
TRACKING CODE: 4539_pH

KEMRON SAMPLE No.	MATERIAL pH
1. L-2 NW	6.08
2. L-2 NW Duplicate	6.16
3. L-2 NW Triplicate	6.19
4.	
5.	
6.	
7.	
8.	
9.	
10.	
Average:	
	6.14

TOTAL POROSITY

PROJECT: Brown and Caldwell
PROJECT No.: SE-0229
TESTING DATE: 11/5/2007
TRACKING CODE: 4539 TP

Total porosity and Pore Volume Calculation	
SAMPLE No.	L-2 NW
1. Bulk Density	68.6 lbs/ft ³
2. Moisture Content	464.0 %
3. Specific Gravity	2.14 -
4. Dry Density	12.2 lbs/ft ³
6. Weight of Solids ₍₁₎	0.1949 g
7. Volume of Solids ₍₁₎	0.0911 cm ³
8. Volume of Voids ₍₁₎	0.9089 cm ³
9. Total Porosity (e)	90.9 %

₁ Calculated for 1 cubic centimeter

UNIT WEIGHT DETERMINATION

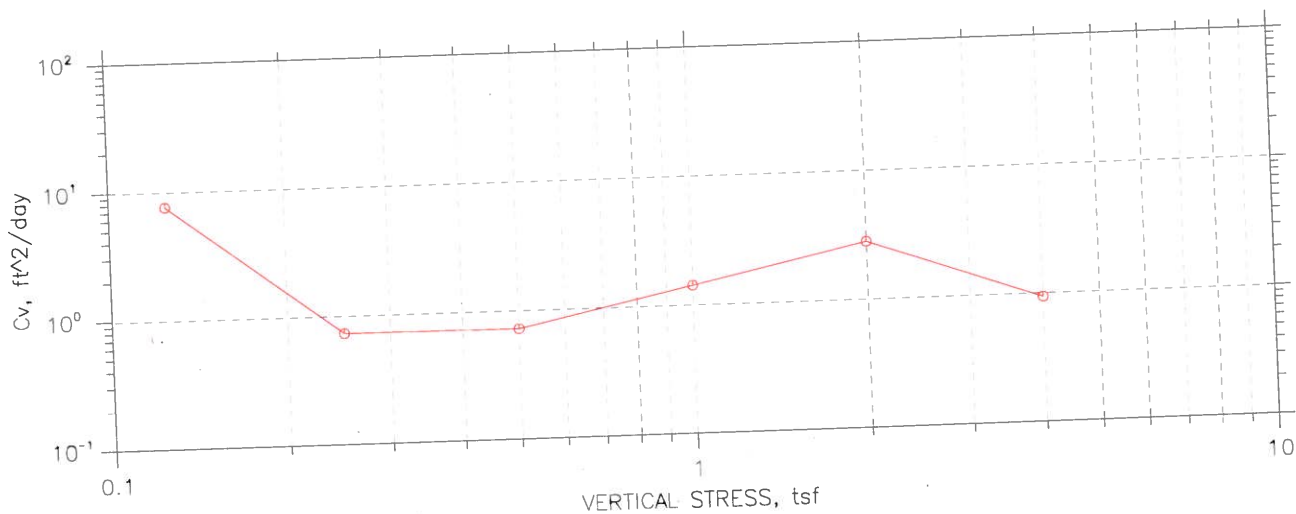
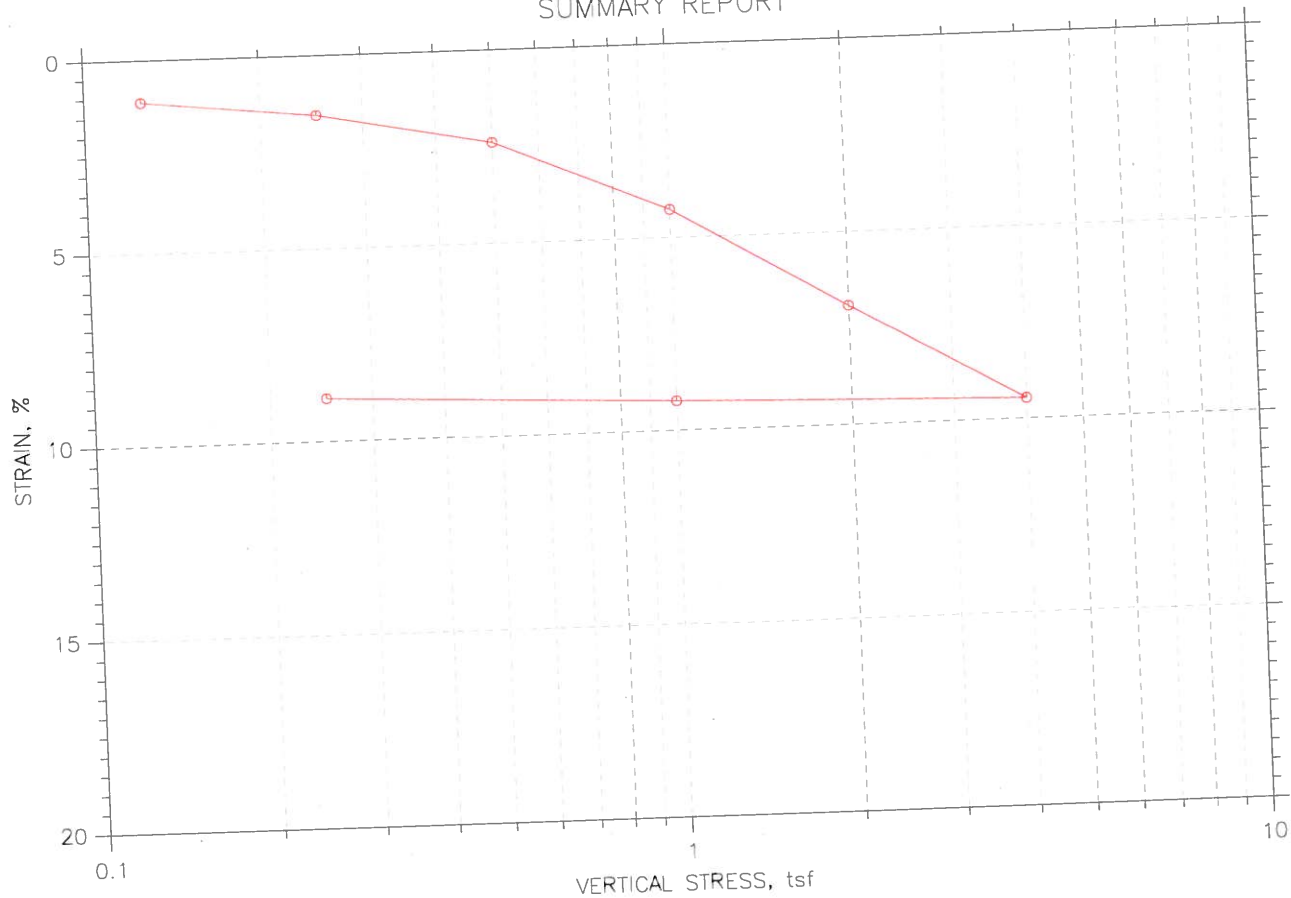
DATA SHEET

PROJECT: Brown and Caldwell
 PROJECT No.: SE-0229
 SAMPLE No.: L-2 SE
 TESTING DATE: 9/6/2007
 TESTED BY: RRB
 TRACKING CODE: 4539 UW

UNIT WEIGHT (DENSITY)			
1. SAMPLE NO.	A	B	C
2. WT OF MOLD (tare weight)	22.49 g	22.49 g	22.49 g
3. WT OF MOLD + SOIL	249.17 g	248.10 g	249.50 g
4. WT OF WET SOIL, W	226.68 g	225.61 g	227.01 g
5. DIAMETER OF SPECIMEN, D	2.00 in	2.00 in	2.00 in
6. HEIGHT OF SPECIMEN, H	4.00 in	4.00 in	4.00 in
7. VOLUME OF SPECIMEN	12.57 in ³	12.57 in ³	12.57 in ³
8. BULK UNIT WEIGHT	68.7 pcf	68.4 pcf	68.8 pcf
9. BULK SPECIFIC GRAVITY	1.1	1.1	1.1
10. AVERAGE BULK UNIT WEIGHT	68.6 pcf		
11. AVERAGE BULK SPECIFIC GRAVITY	1.1		

CONSOLIDATION TEST DATA

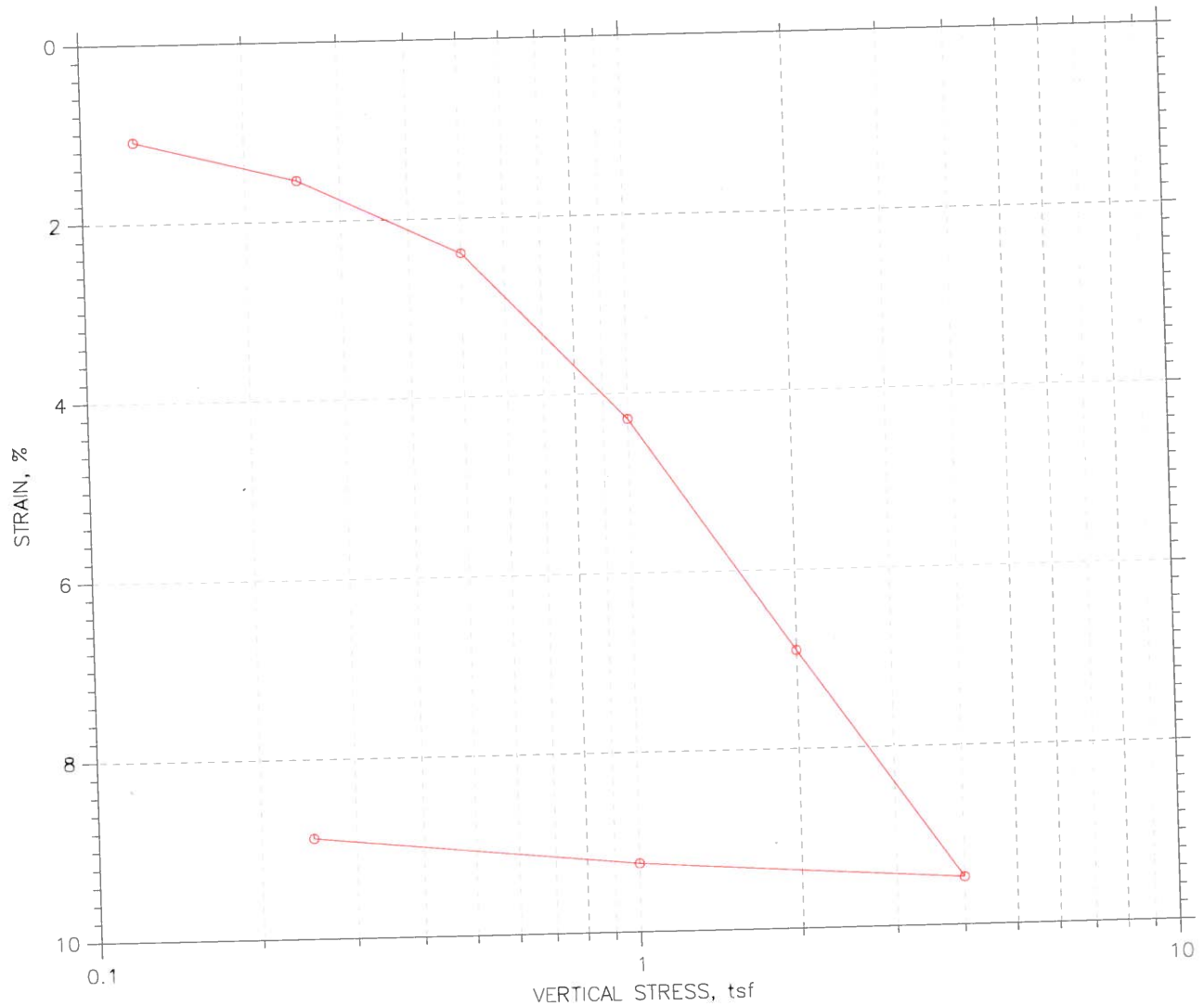
SUMMARY REPORT



GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-004	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21674	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 tsf				114.82	108.31
Preconsolidation Pressure: 0 tsf				36.15	39.67
Compression Index: 0				85.54	91.09
Diameter: 2.5 in				3.49	3.09
Height: 1.008 in					
LL: NP					
PL: NP					
PI: NP					
GS: 2.60					

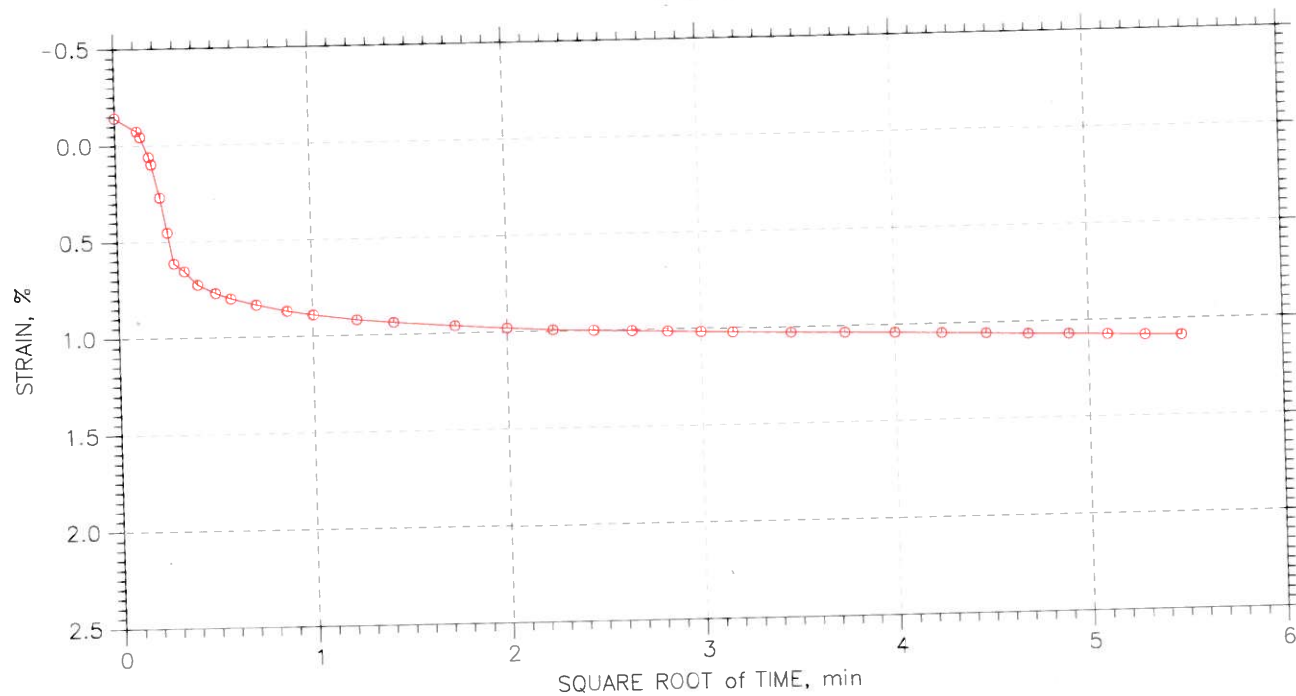
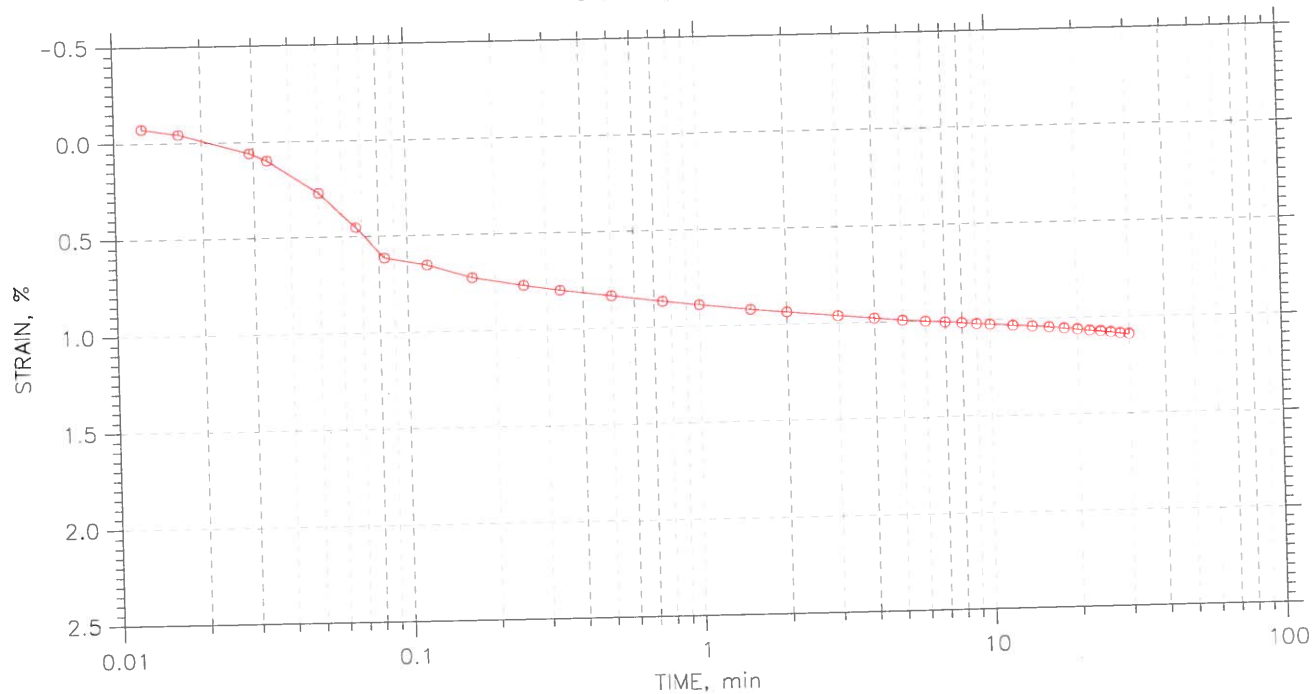
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-004	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21674	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 8

Stress: 0.125 tsf



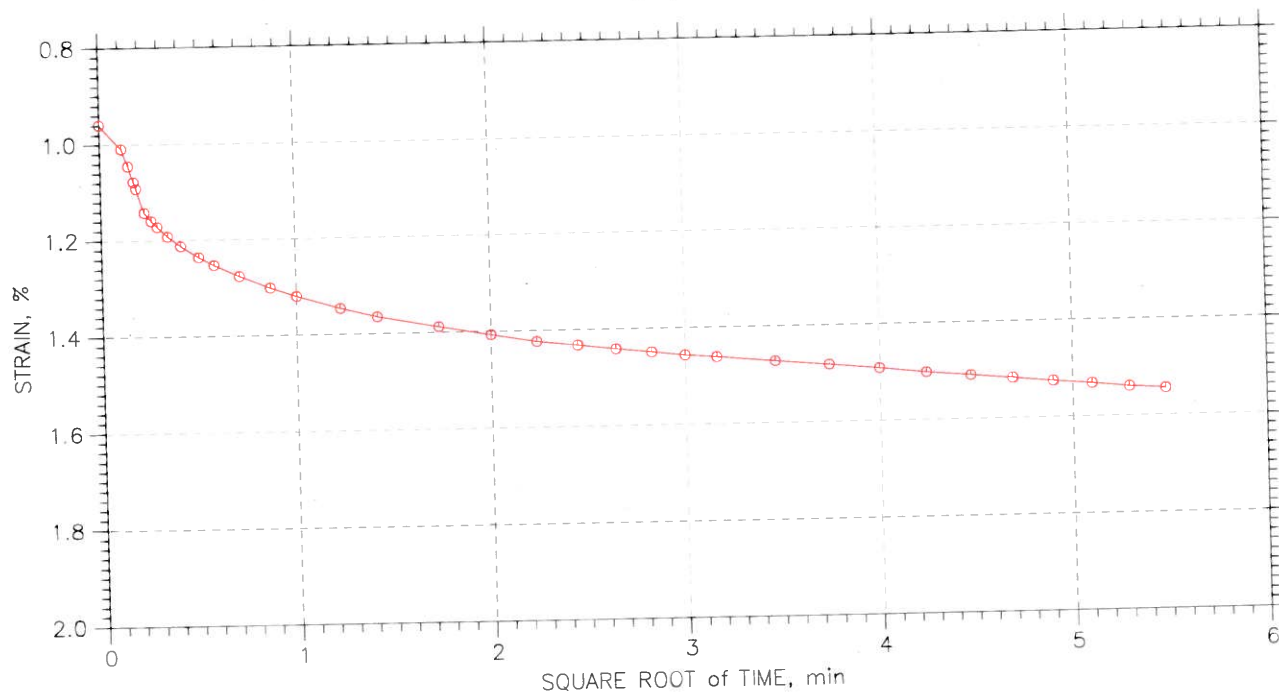
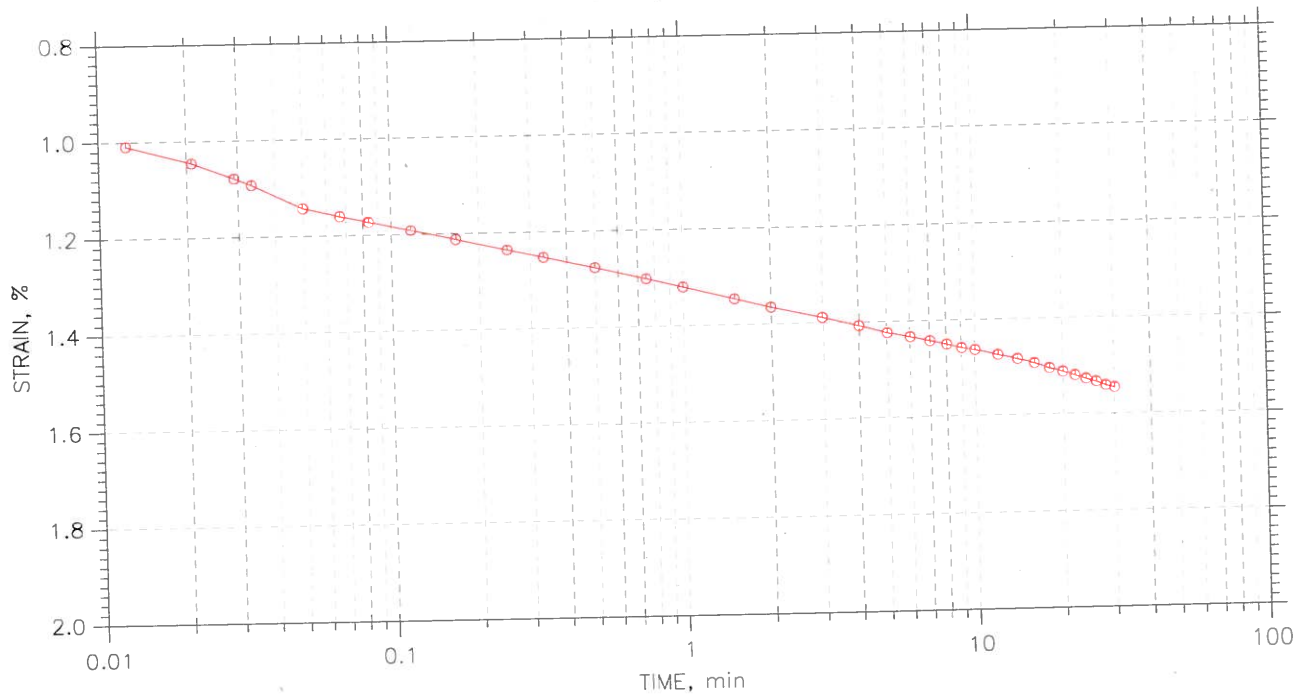
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-004	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21674	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 8

Stress: 0.25 tsf



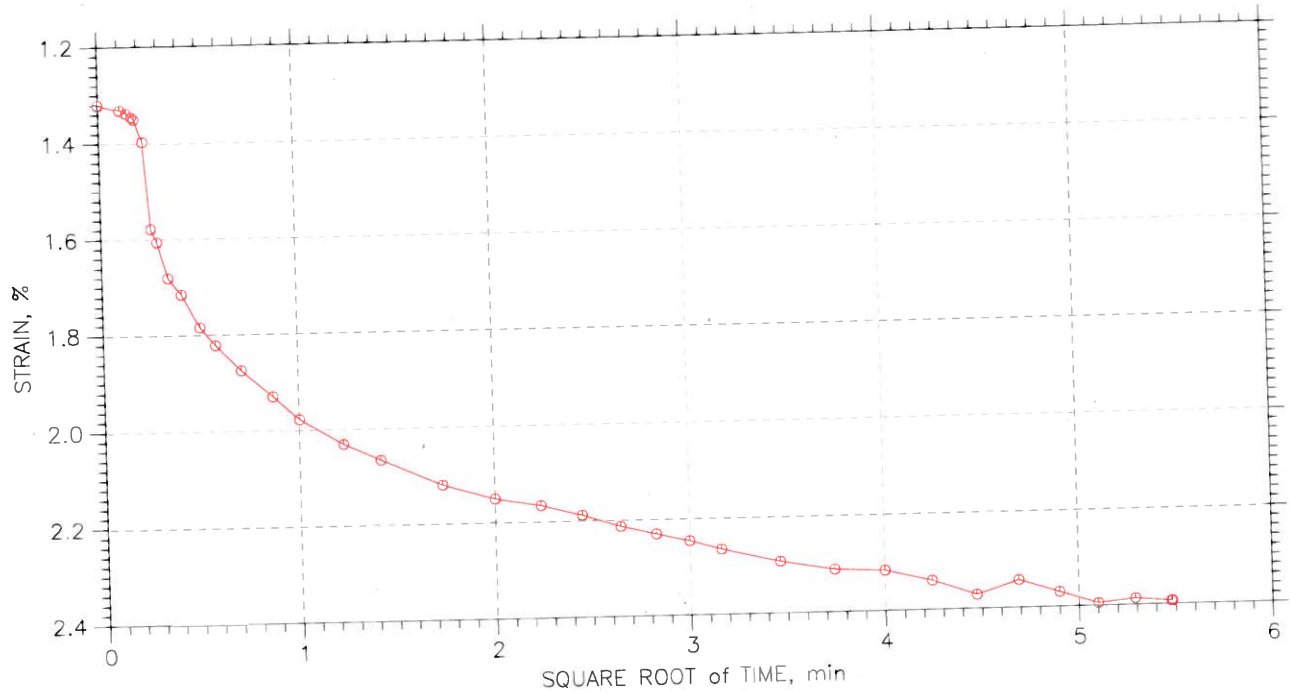
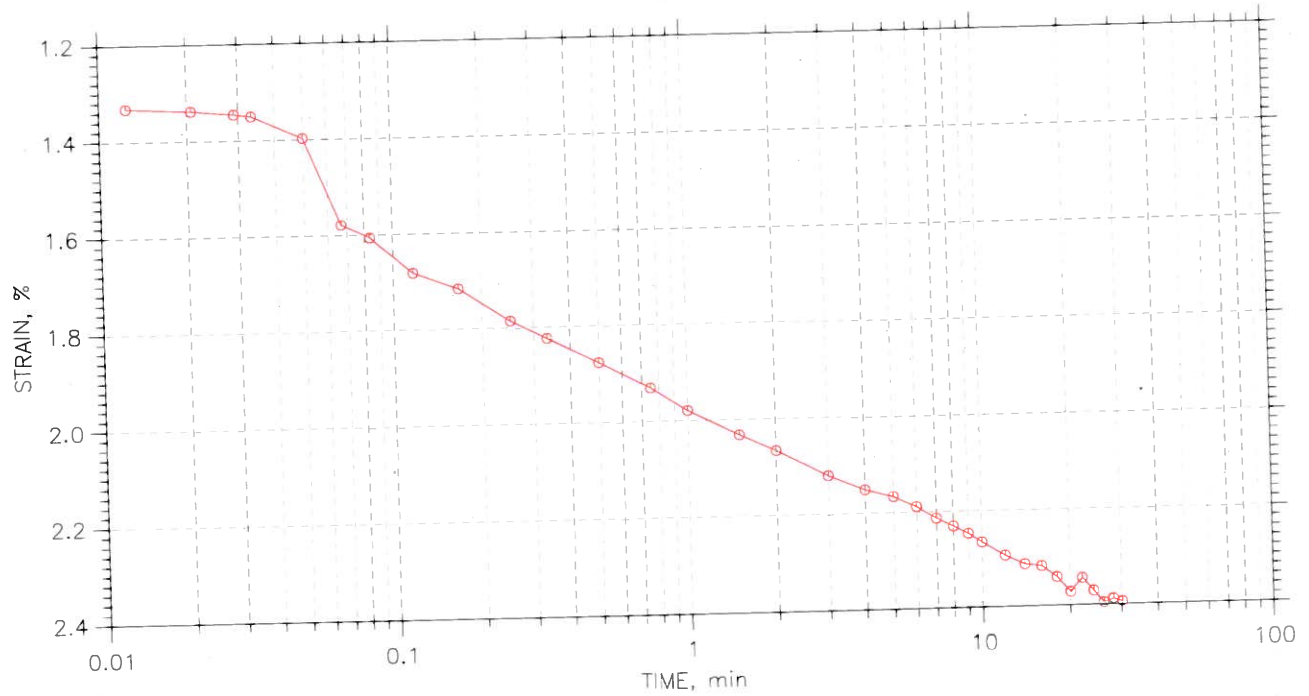
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-004	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21674	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 8

Stress: 0.5 tsf



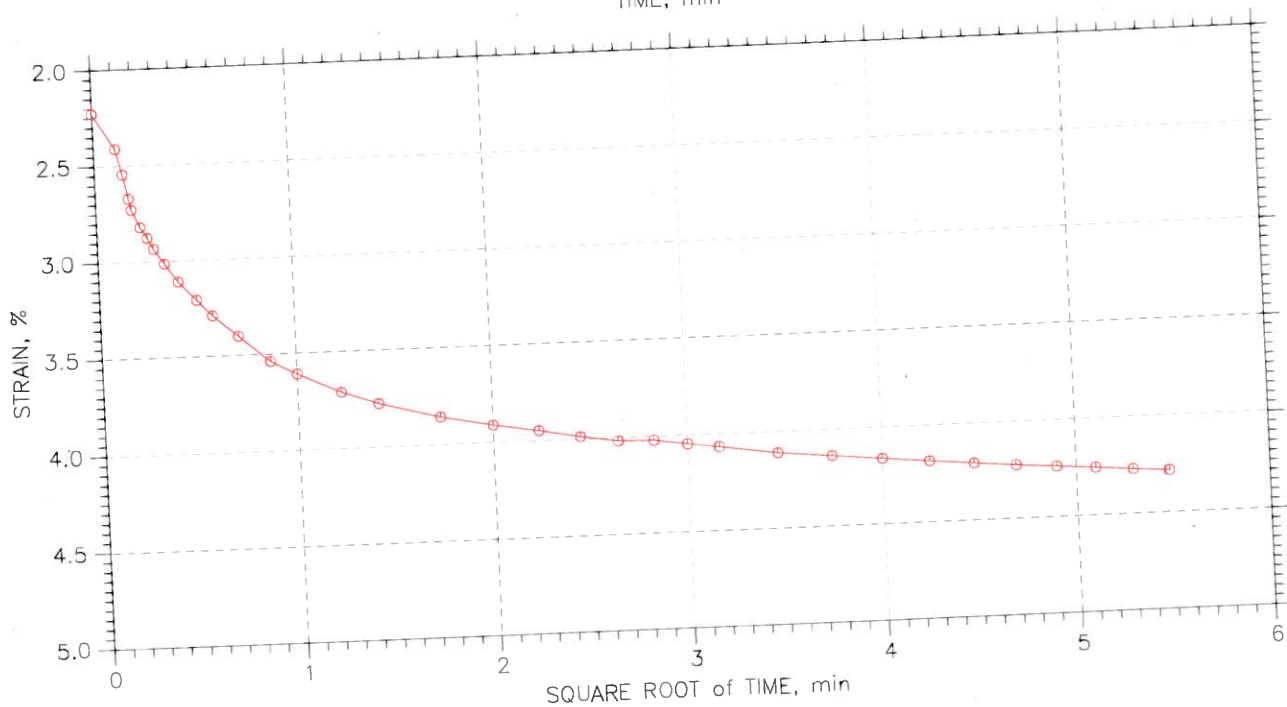
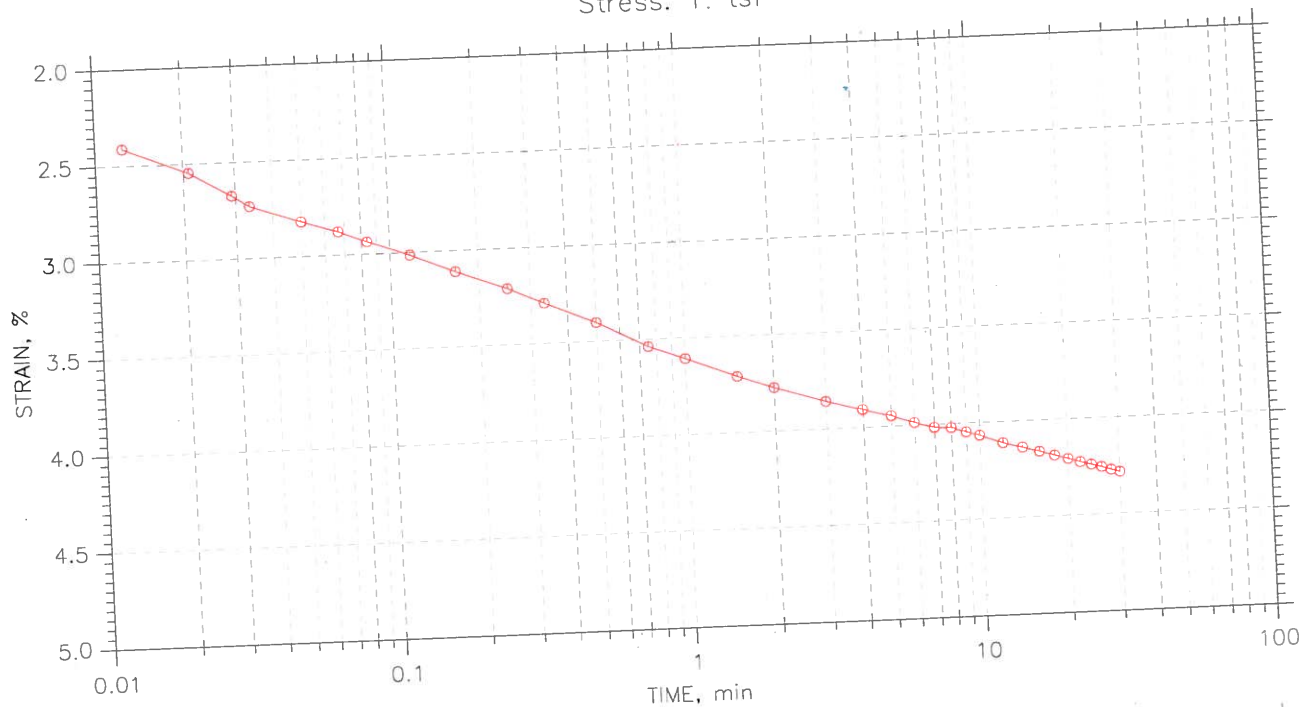
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-004	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21674	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 8

Stress: 1. tsf



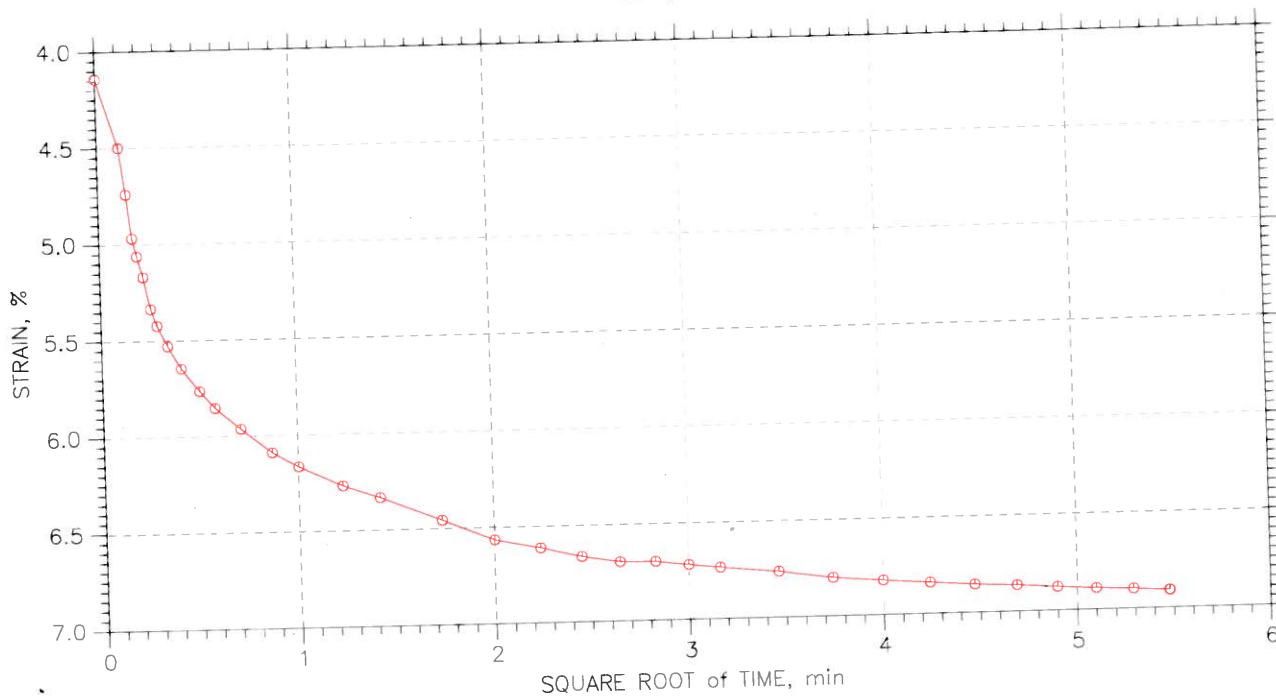
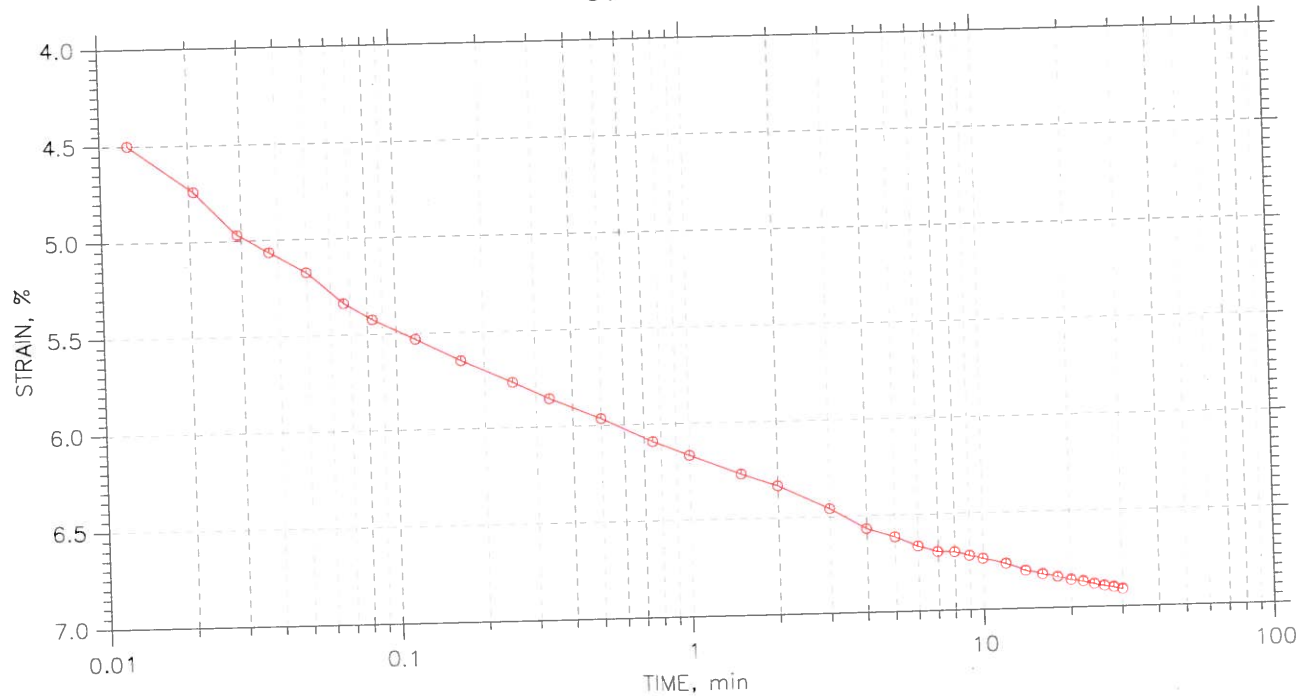
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-004	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21674	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 8

Stress: 2. tsf



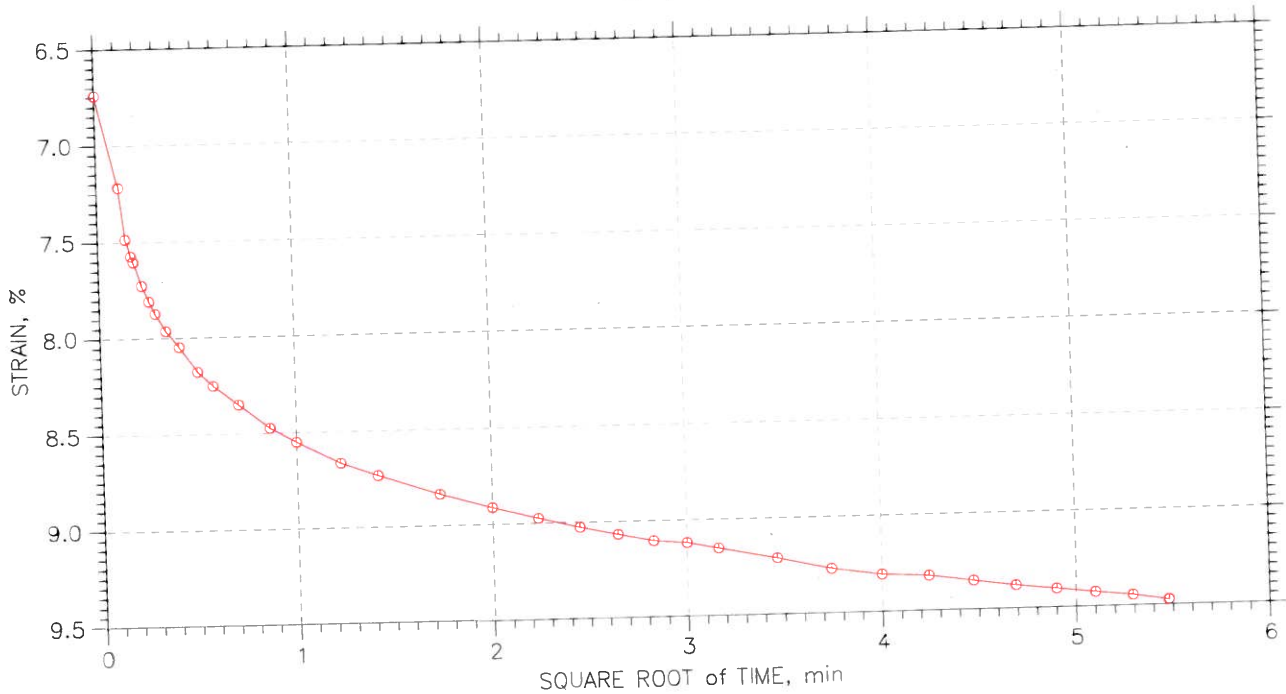
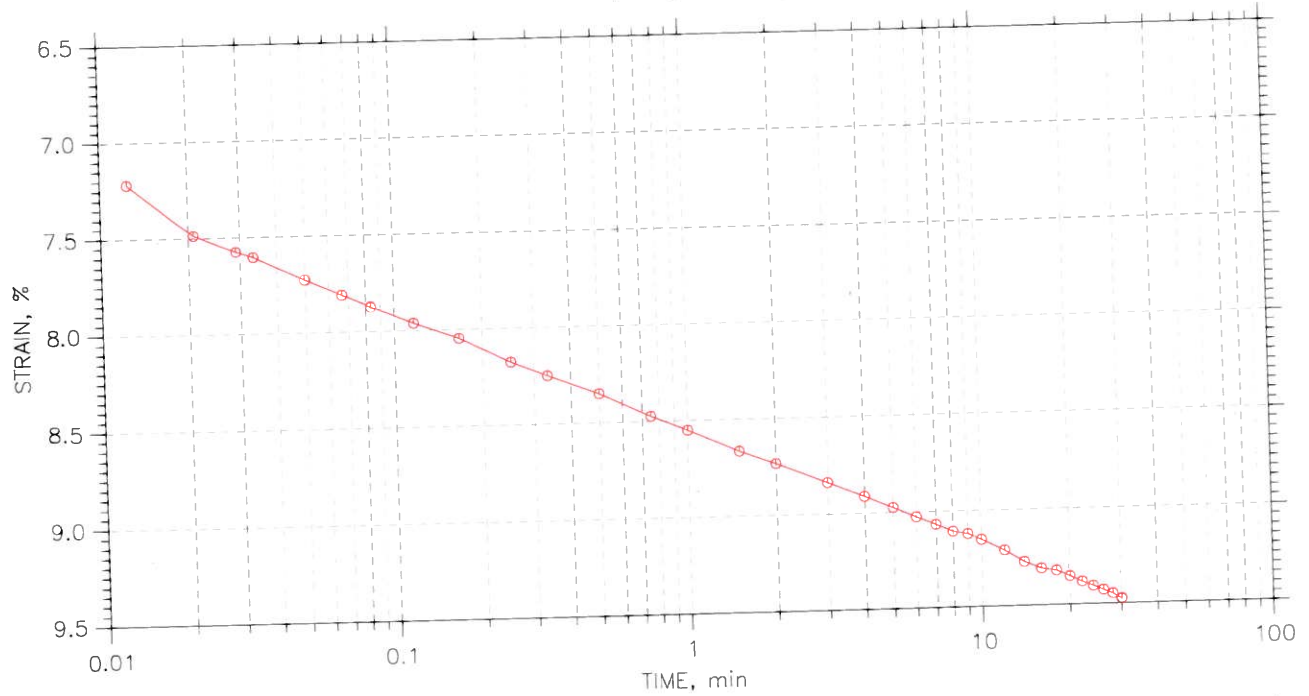
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-004	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21674	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 8

Stress: 4. tsf



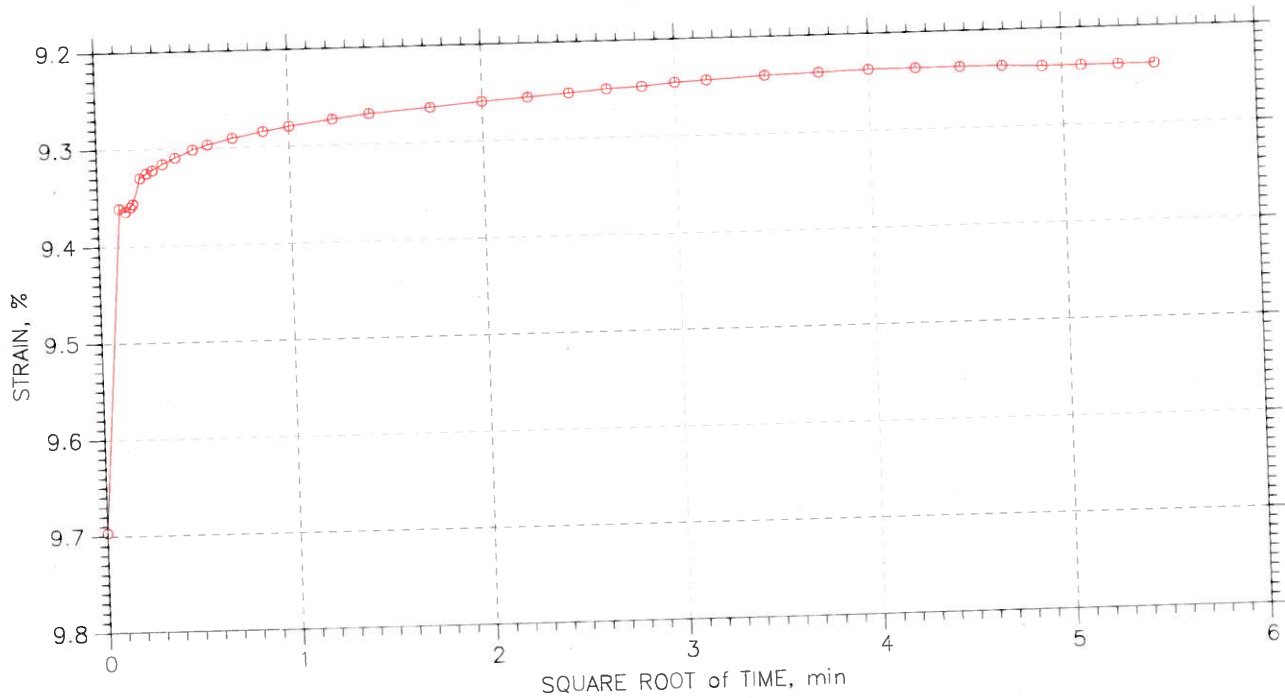
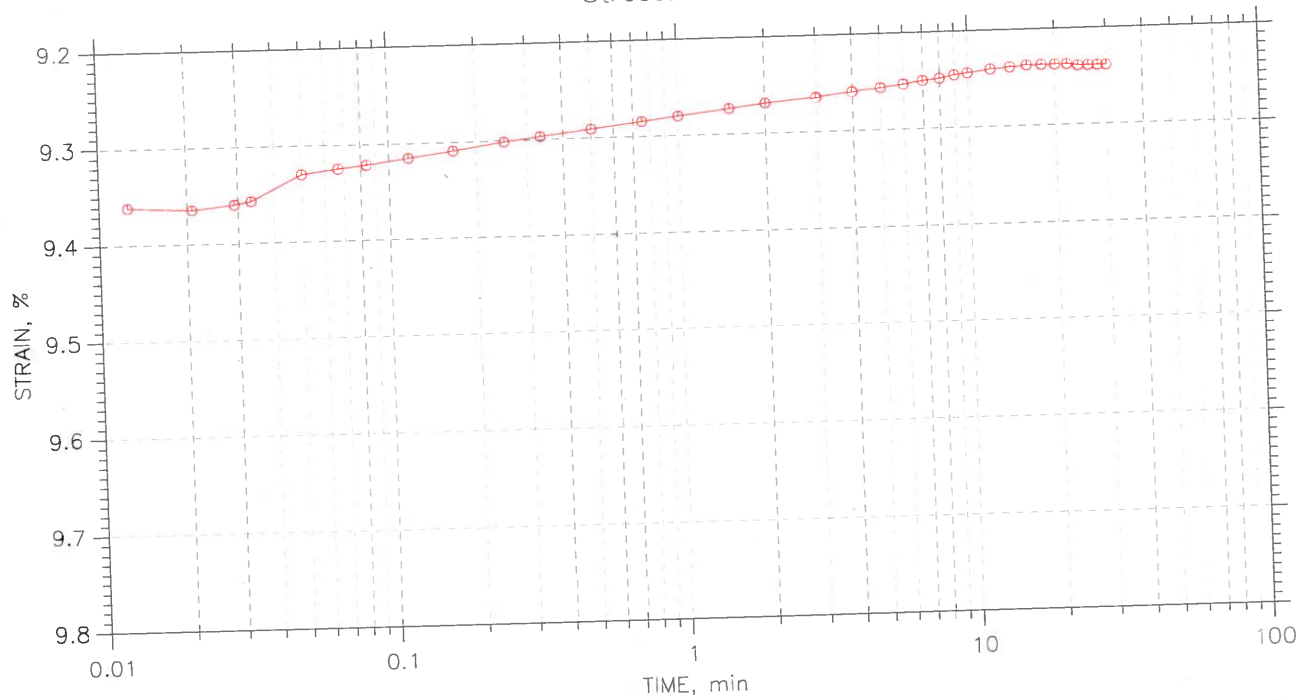
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-004	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21674	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 8

Stress: 1. tsf



GeoTesting
express
the groundwork for success

Project: Lagoon Stabilization

Location: ---

Project No.: GTX-1304

Boring No.: ---

Tested By: mm

Checked By: ca

Sample No.: 0229-004

Test Date: 10-24-07

Depth: 10-12 ft

Test No.: 21674

Sample Type: UD

Elevation: ---

Description: Stabilized Soil

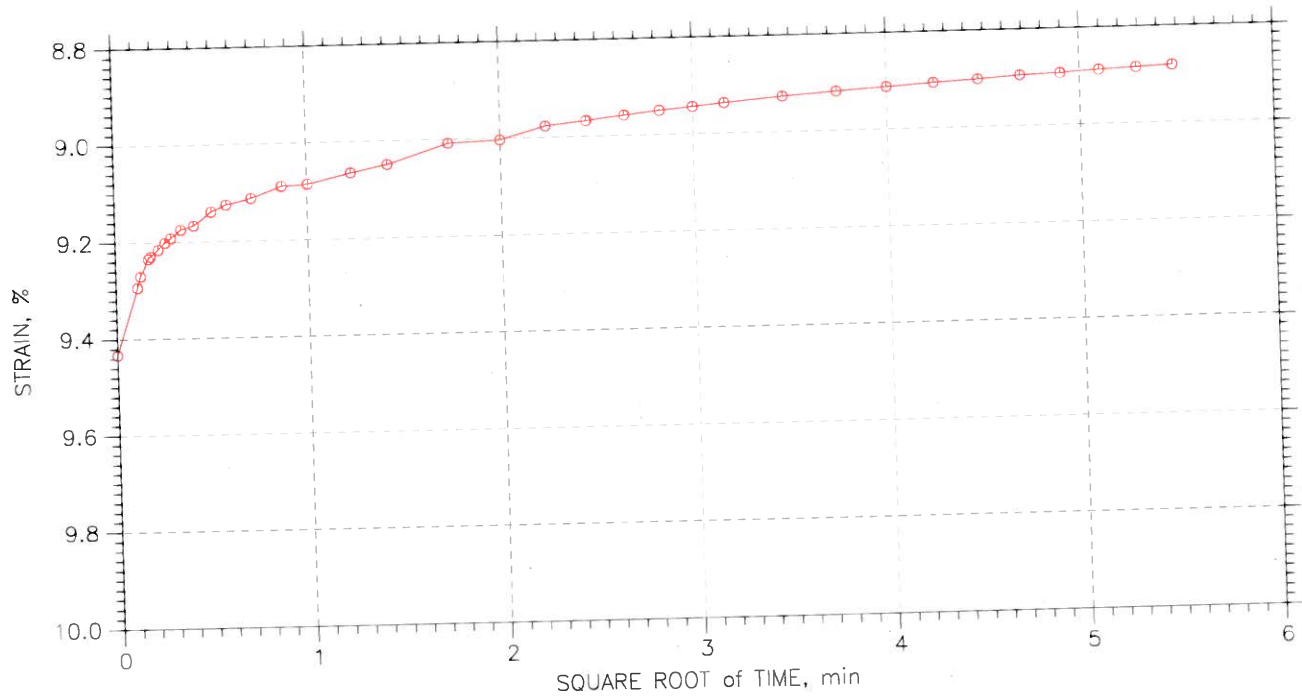
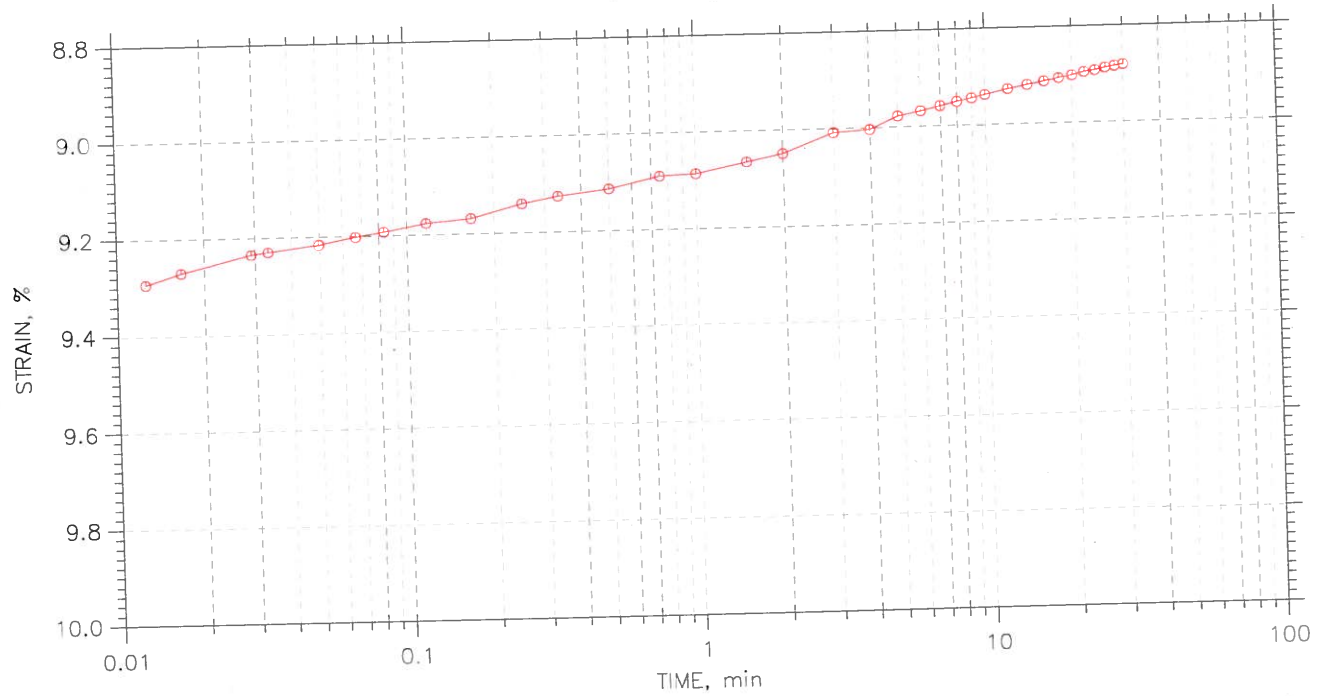
Remarks: System 5077

CONSOLIDATION TEST DATA

TIME CURVES

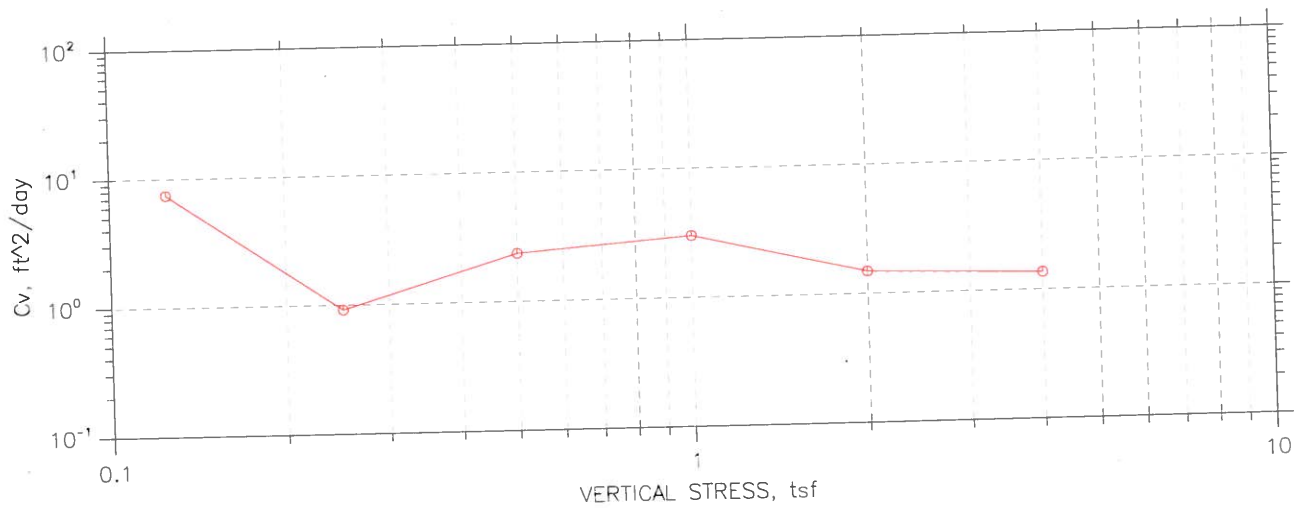
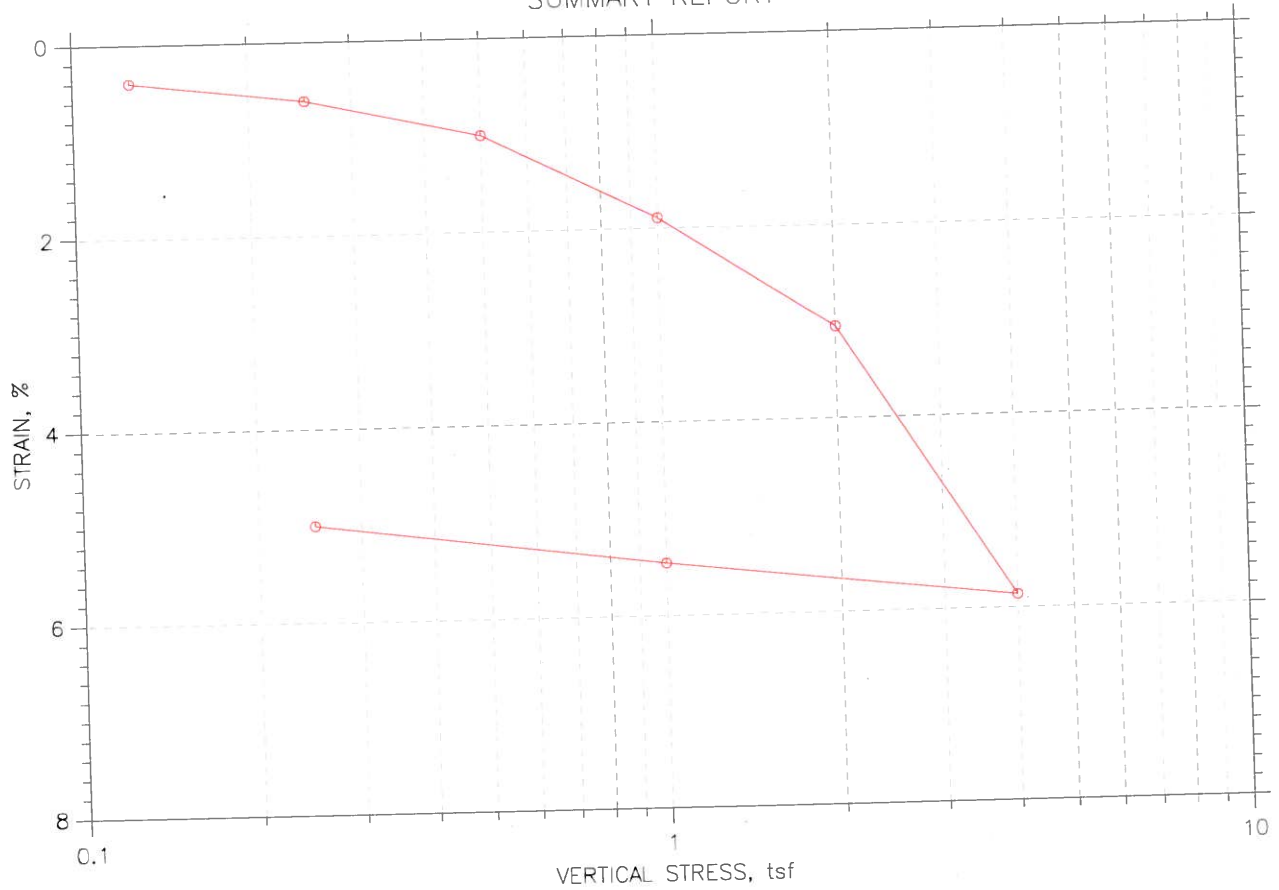
Constant Load Step: 8 of 8

Stress: 0.25 tsf



GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-004	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21674	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

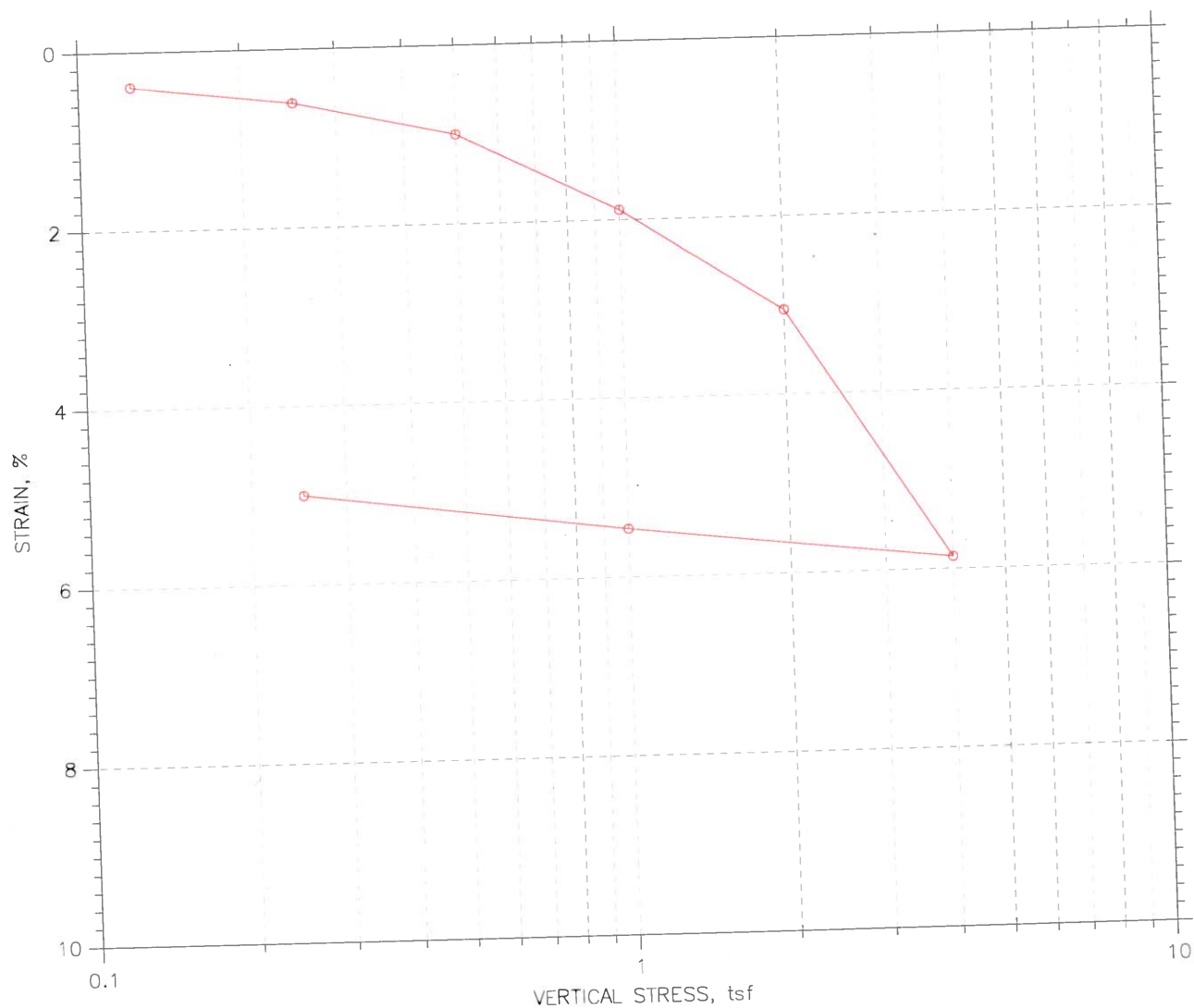
CONSOLIDATION TEST DATA SUMMARY REPORT



GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-005	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21675	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 tsf				119.03	114.10
Preconsolidation Pressure: 0 tsf				36.22	38.13
Compression Index: 0				88.89	91.08
Diameter: 2.5 in				3.48	3.26
Height: 1.009 in					
LL: NP	PL: NP	PI: NP	GS: 2.60		

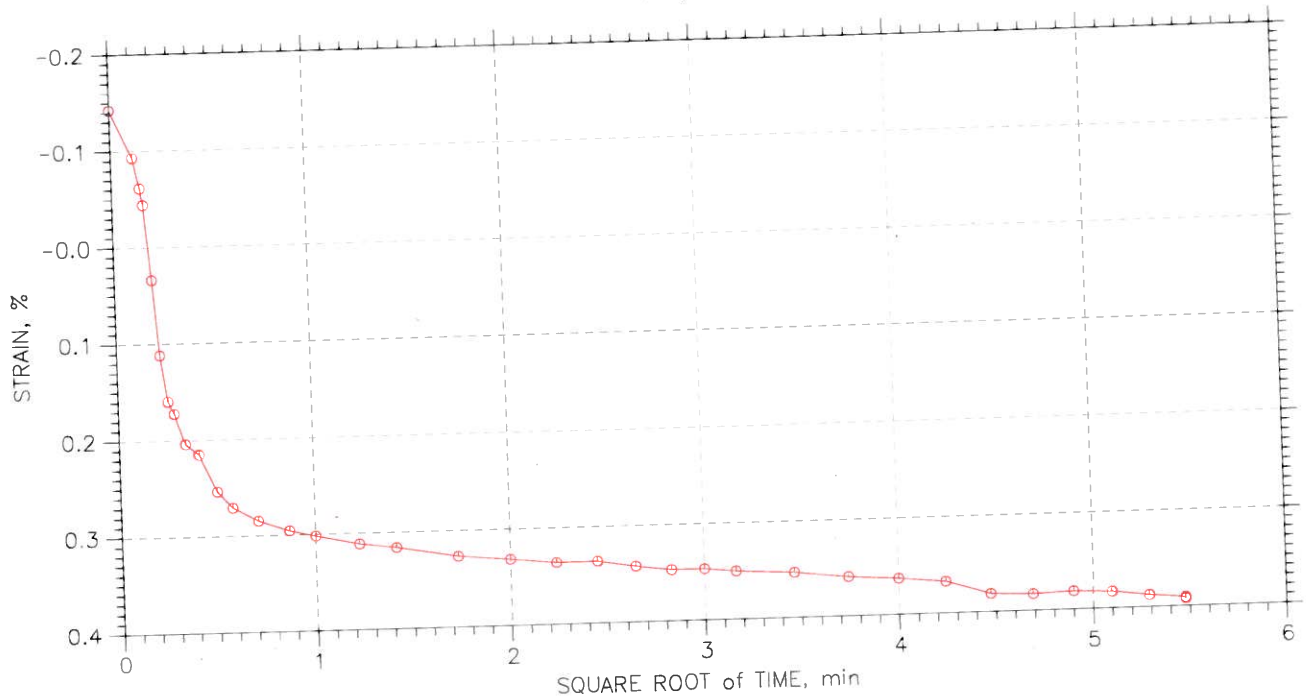
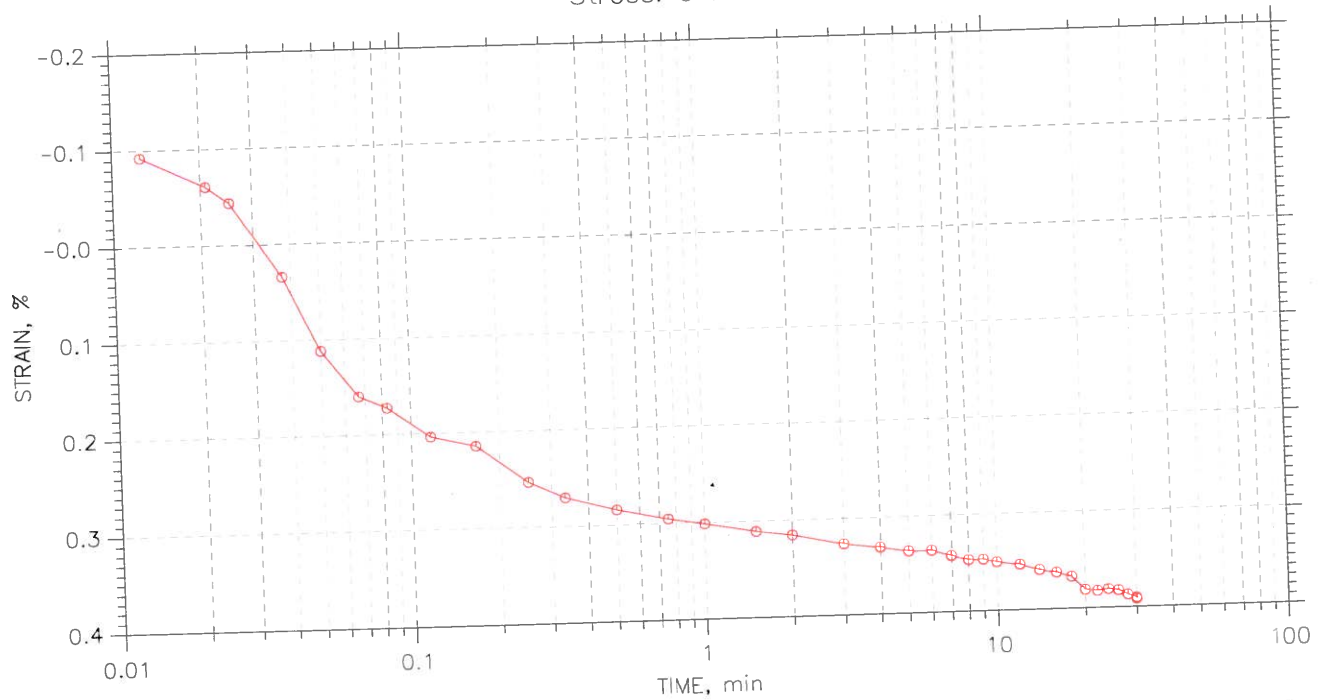
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-005	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21675	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 8

Stress: 0.125 tsf



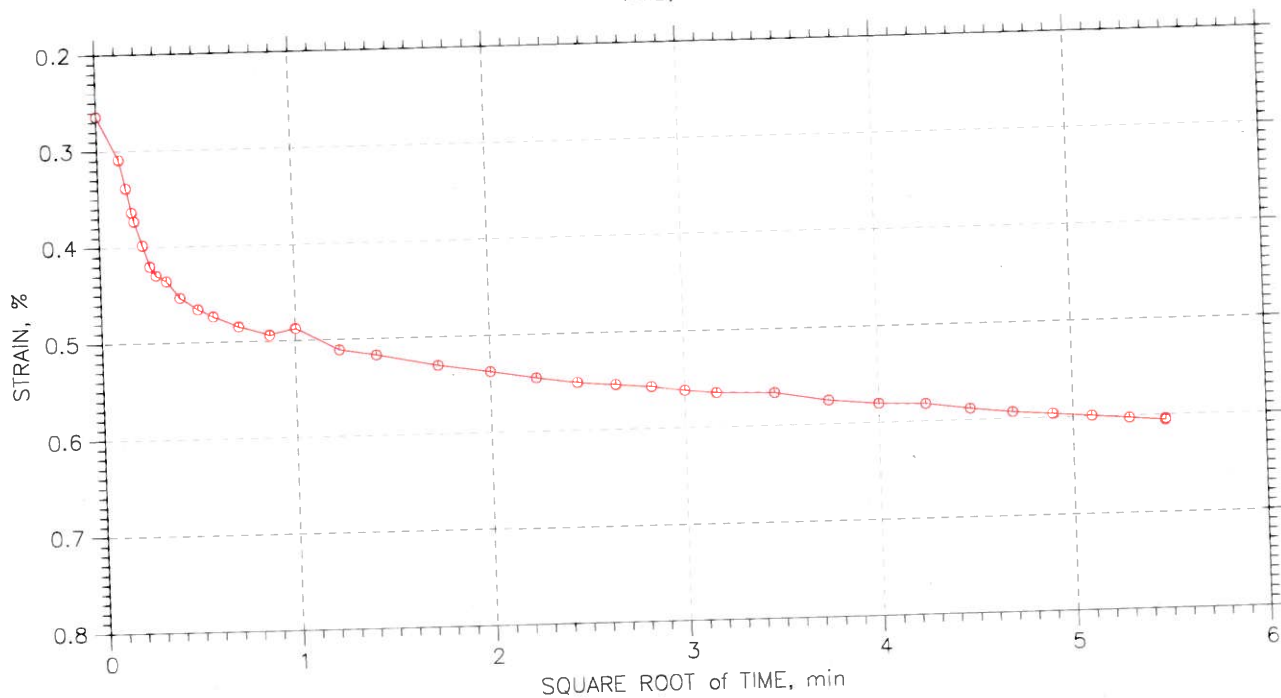
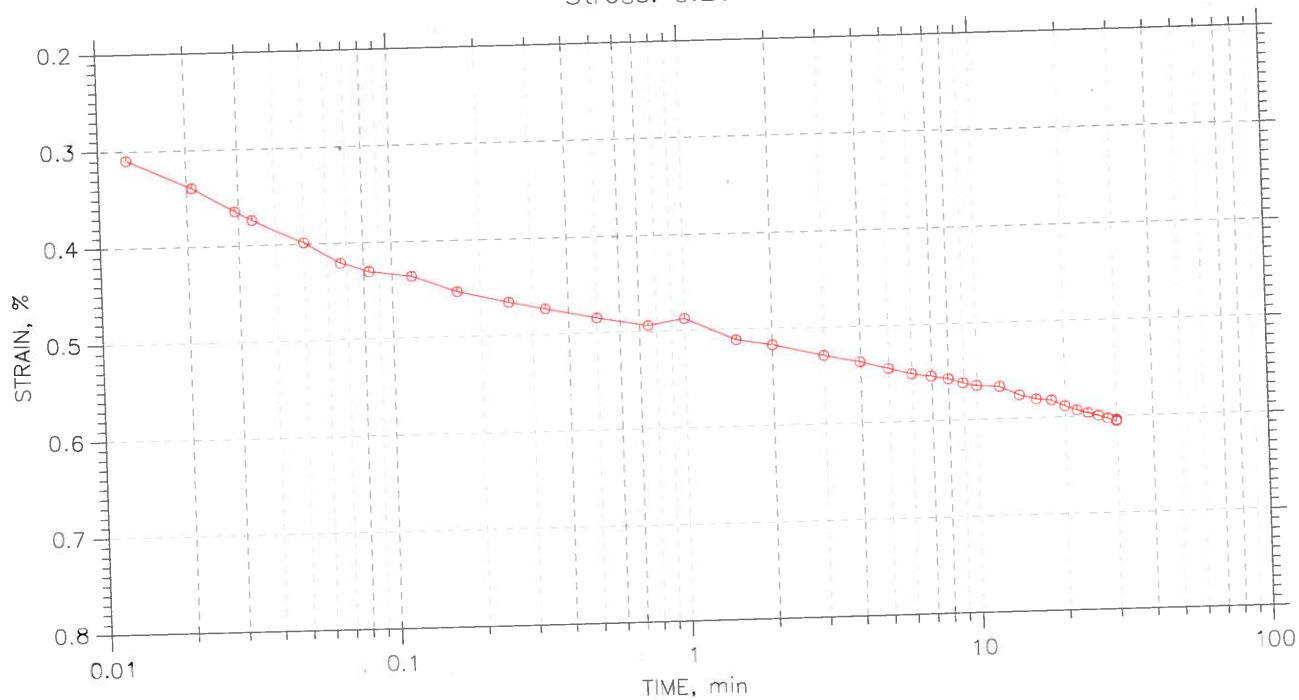
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-005	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21675	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 8

Stress: 0.25 tsf



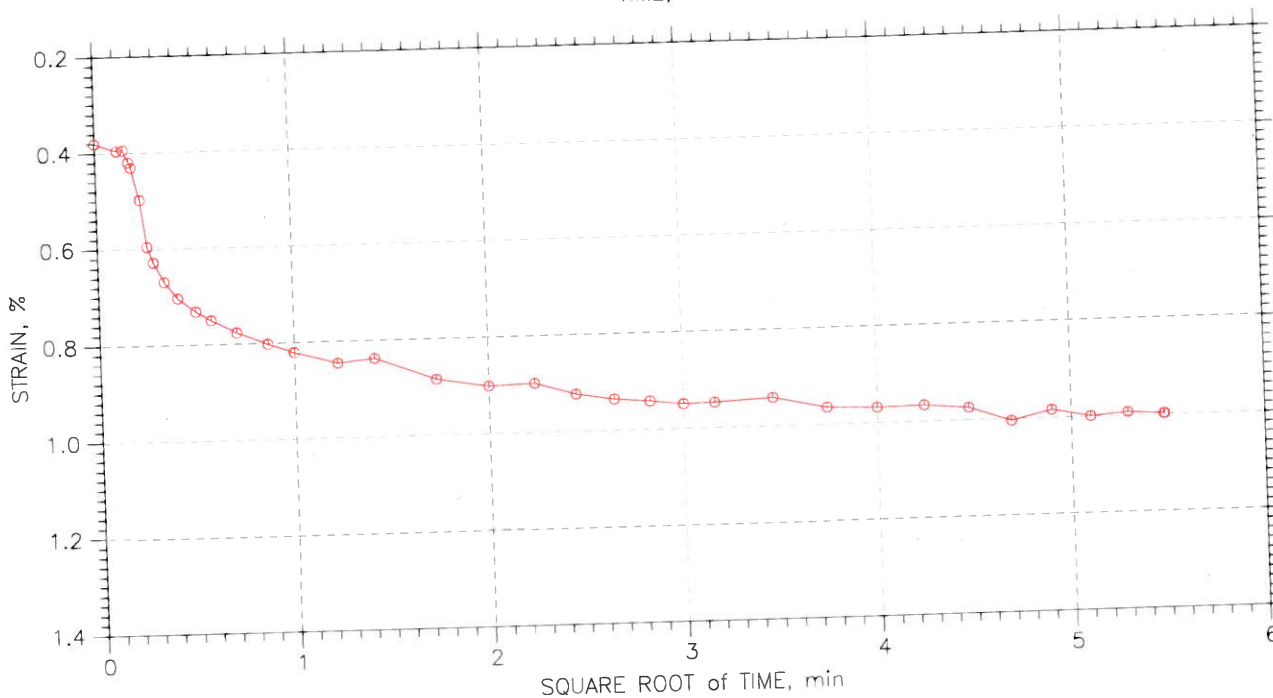
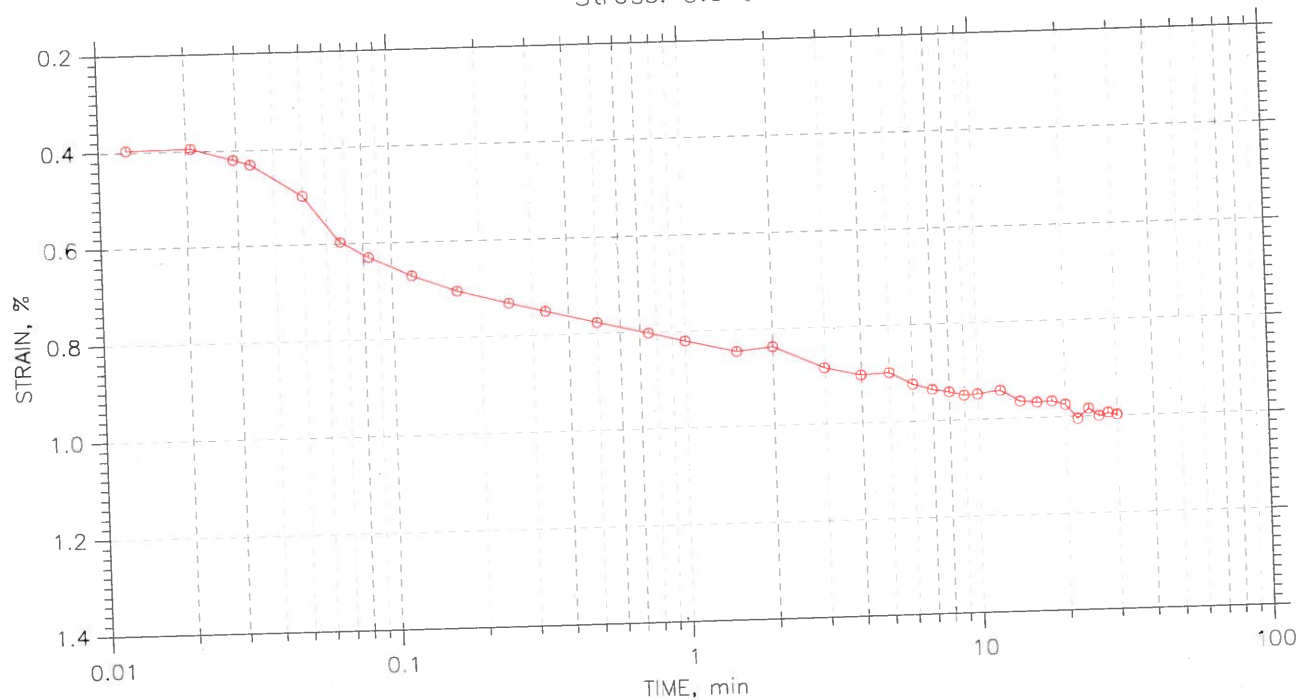
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-005	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21675	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 8

Stress: 0.5 tsf



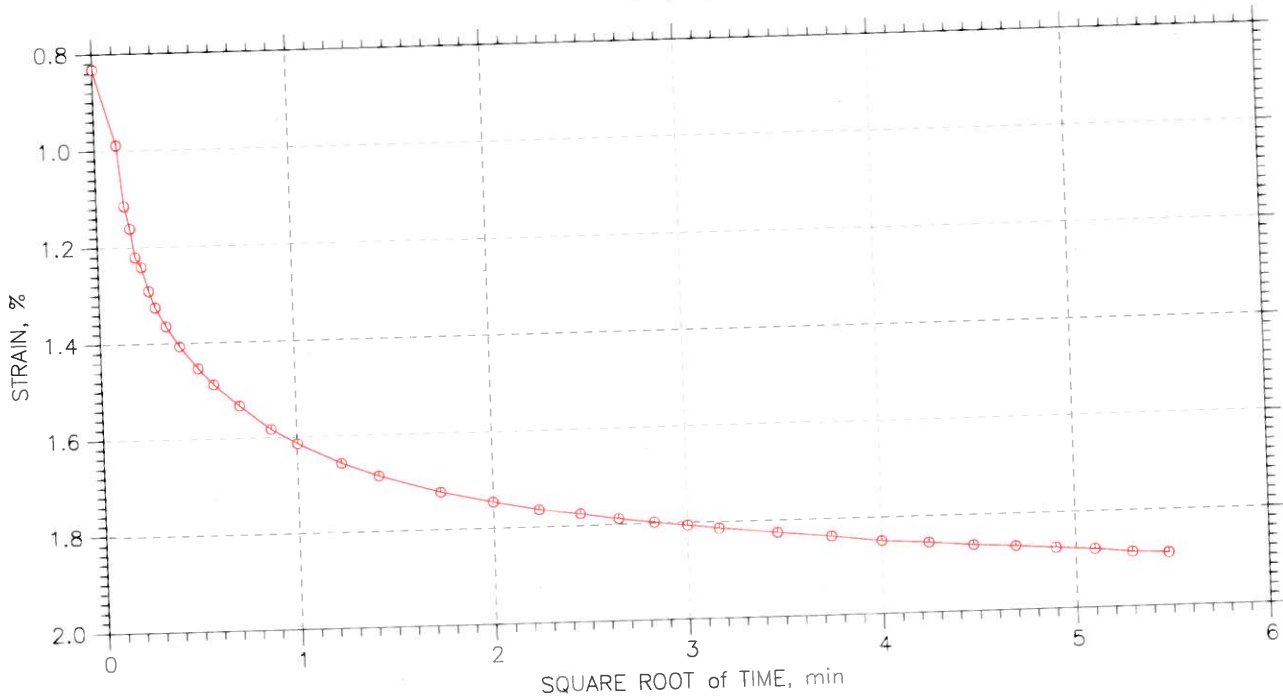
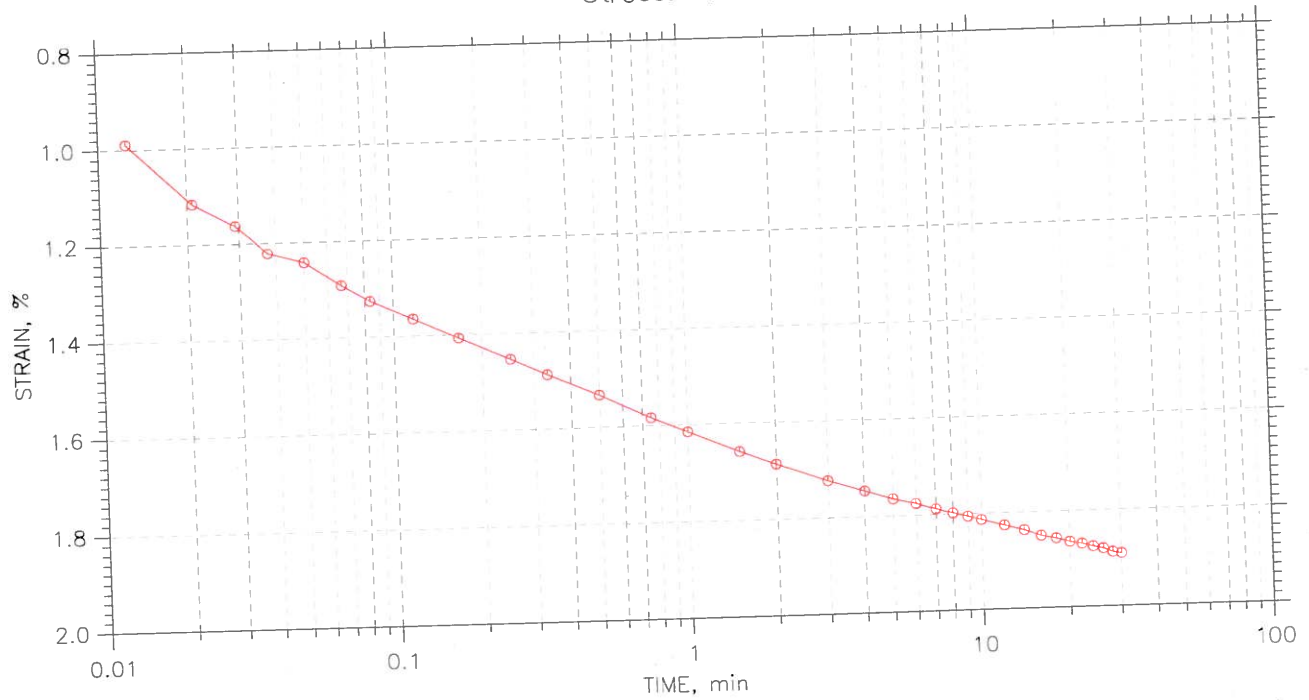
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-005	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21675	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 8

Stress: 1. tsf



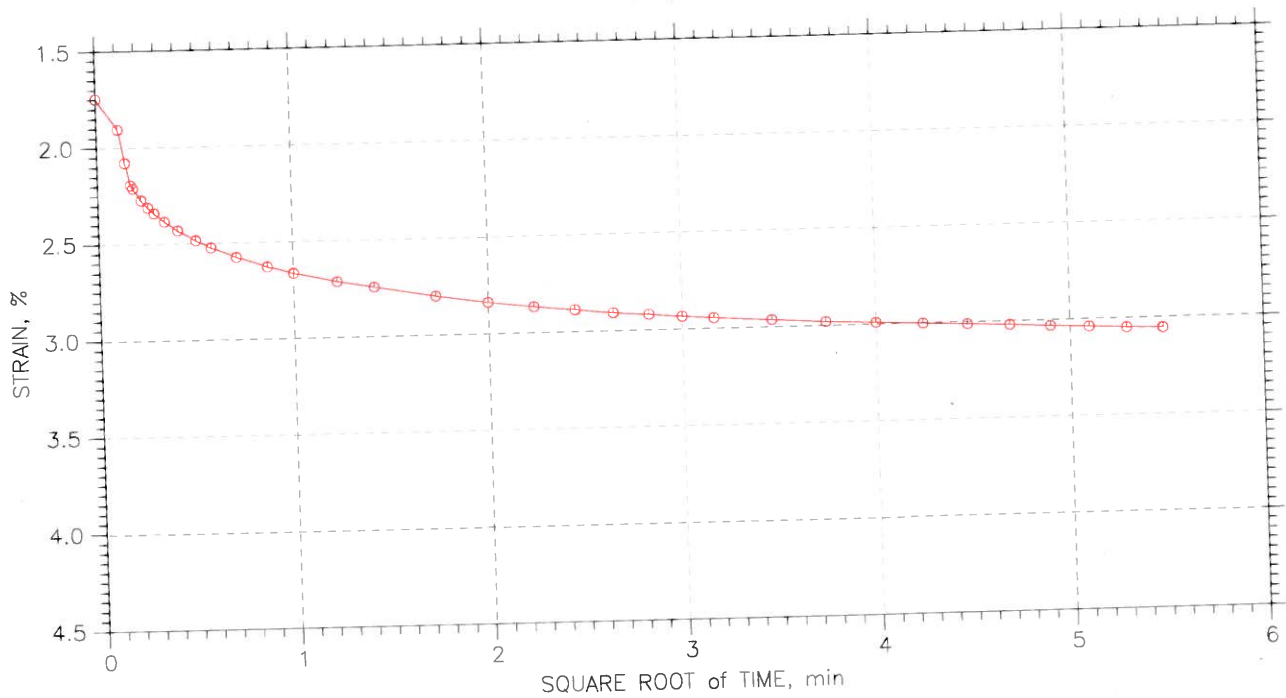
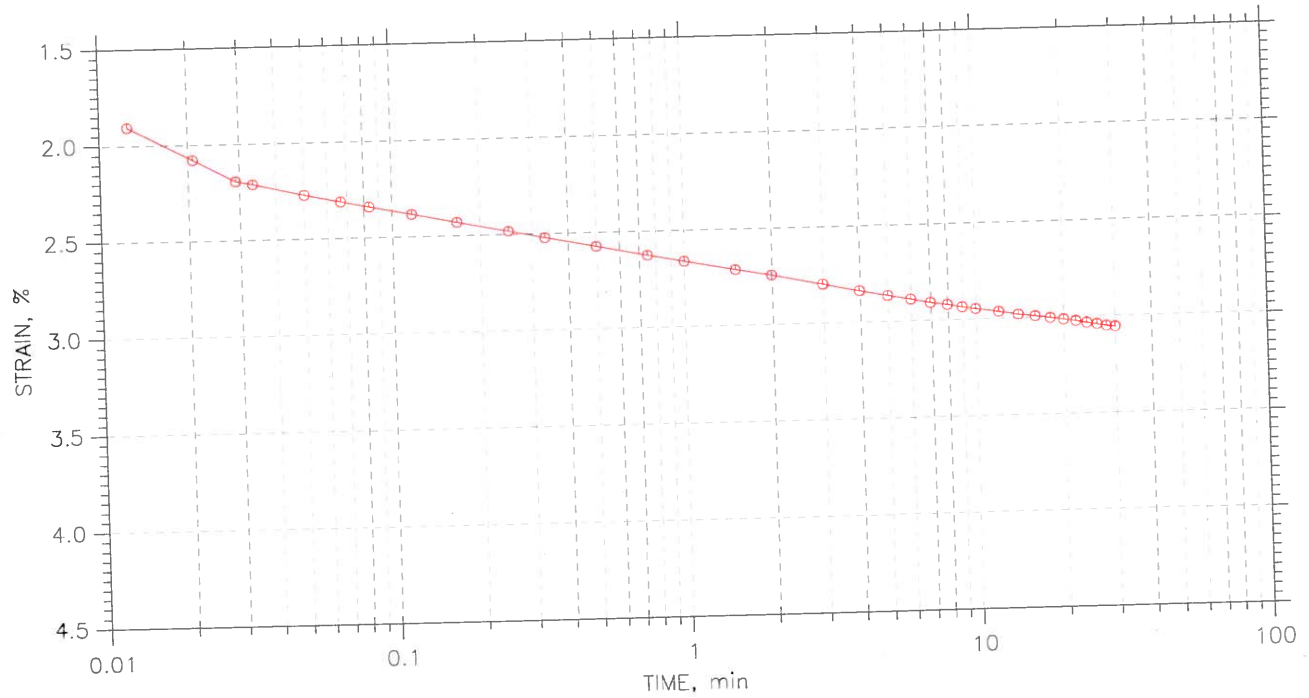
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-005	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21675	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 8

Stress: 2. tsf



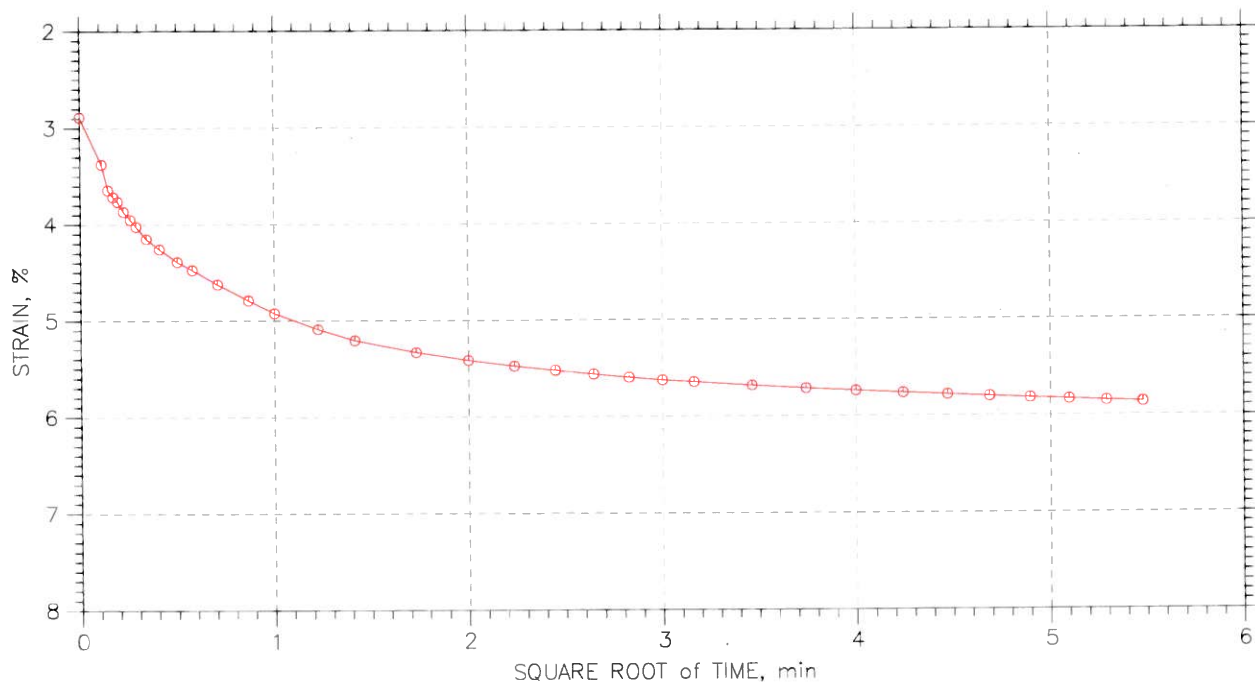
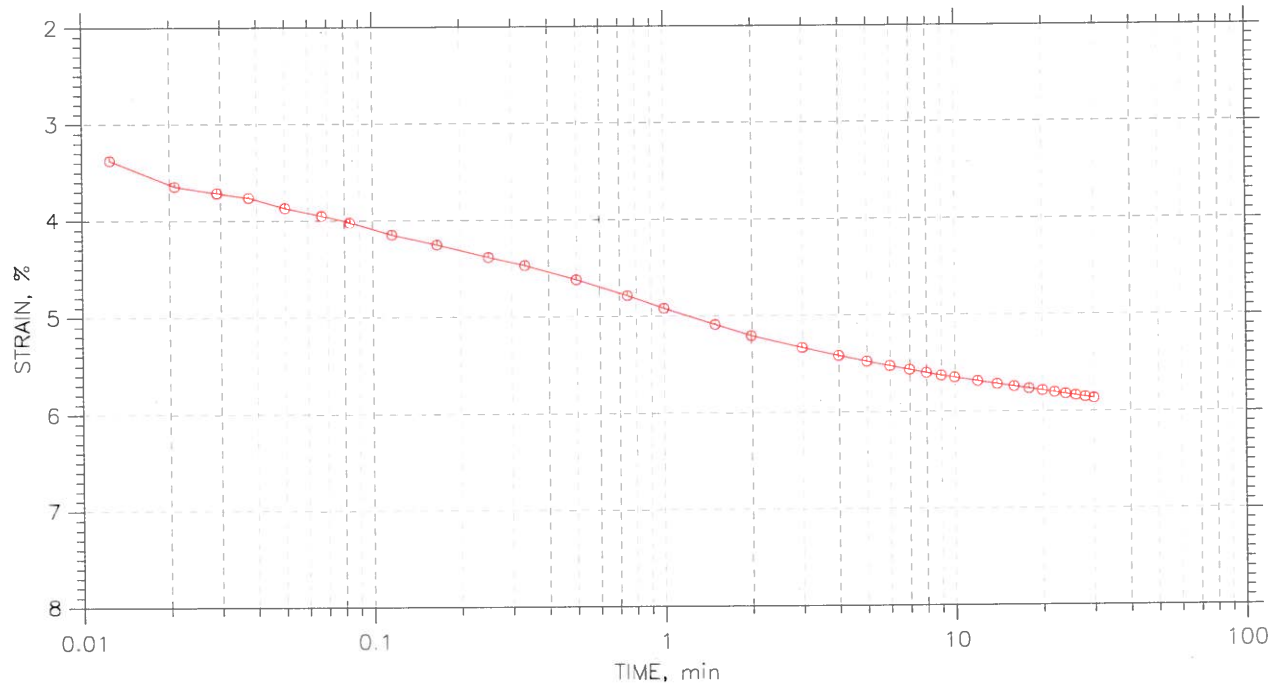
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-005	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21675	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 8

Stress: 4. tsf



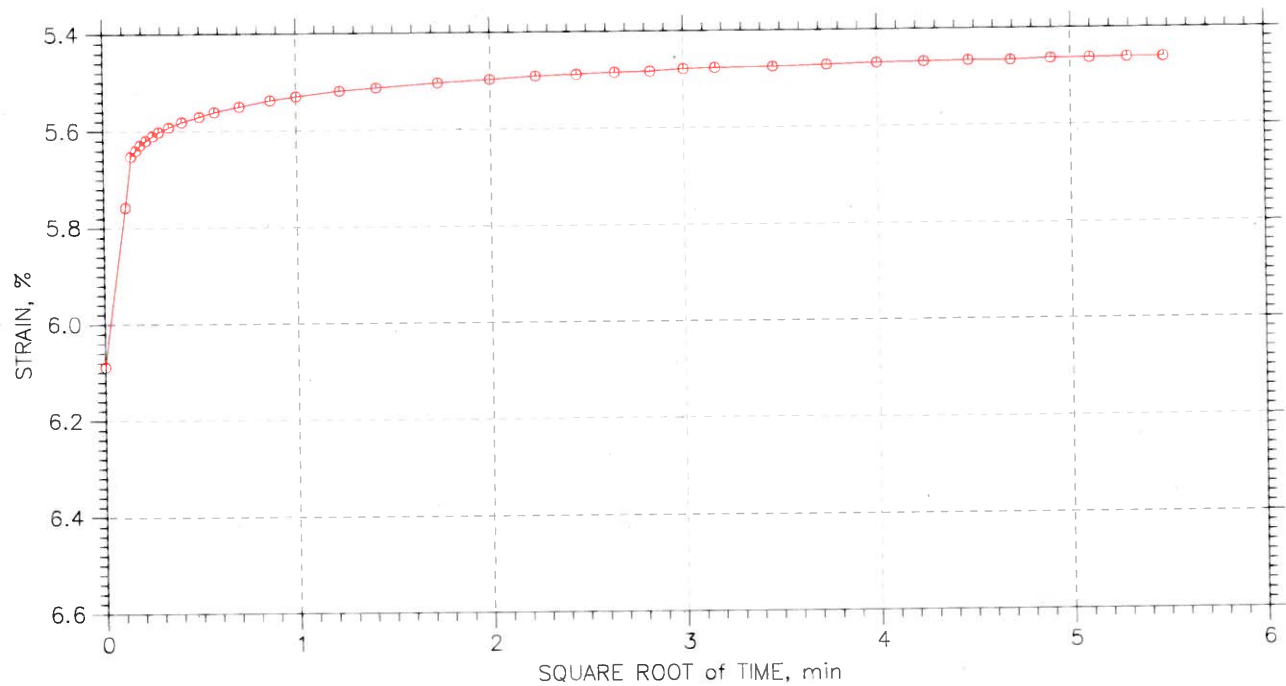
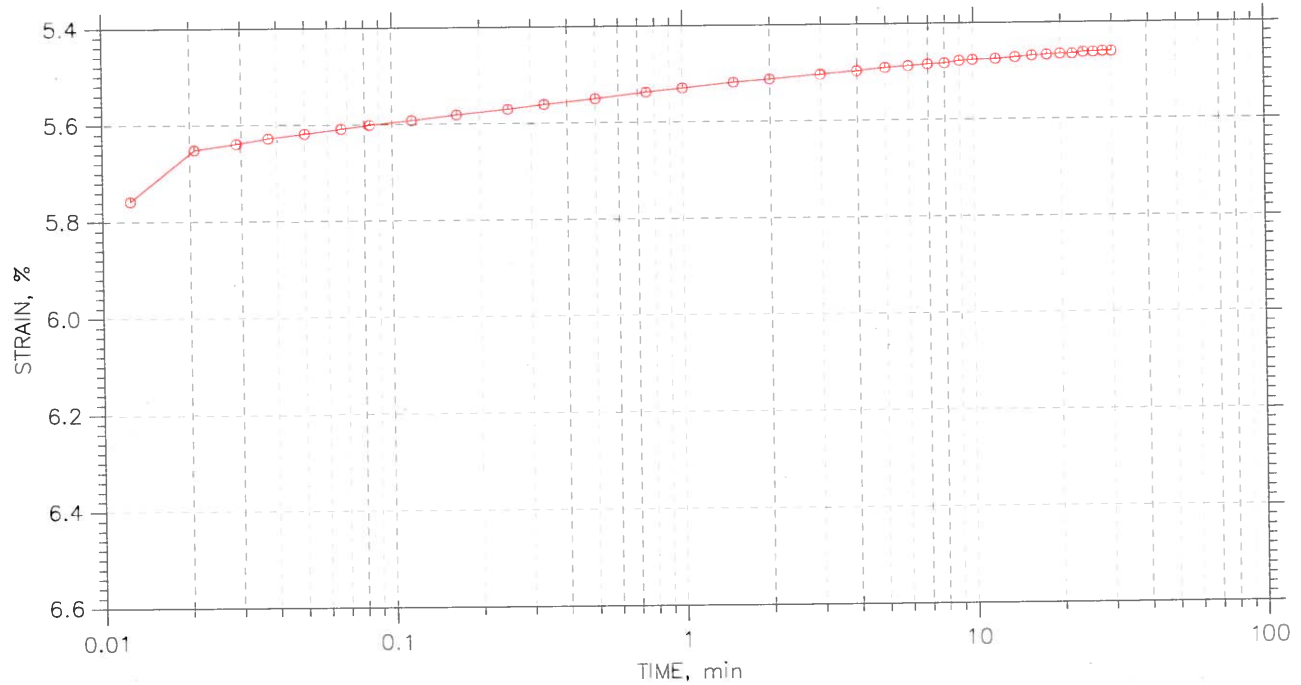
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-005	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21675	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 8

Stress: 1. tsf



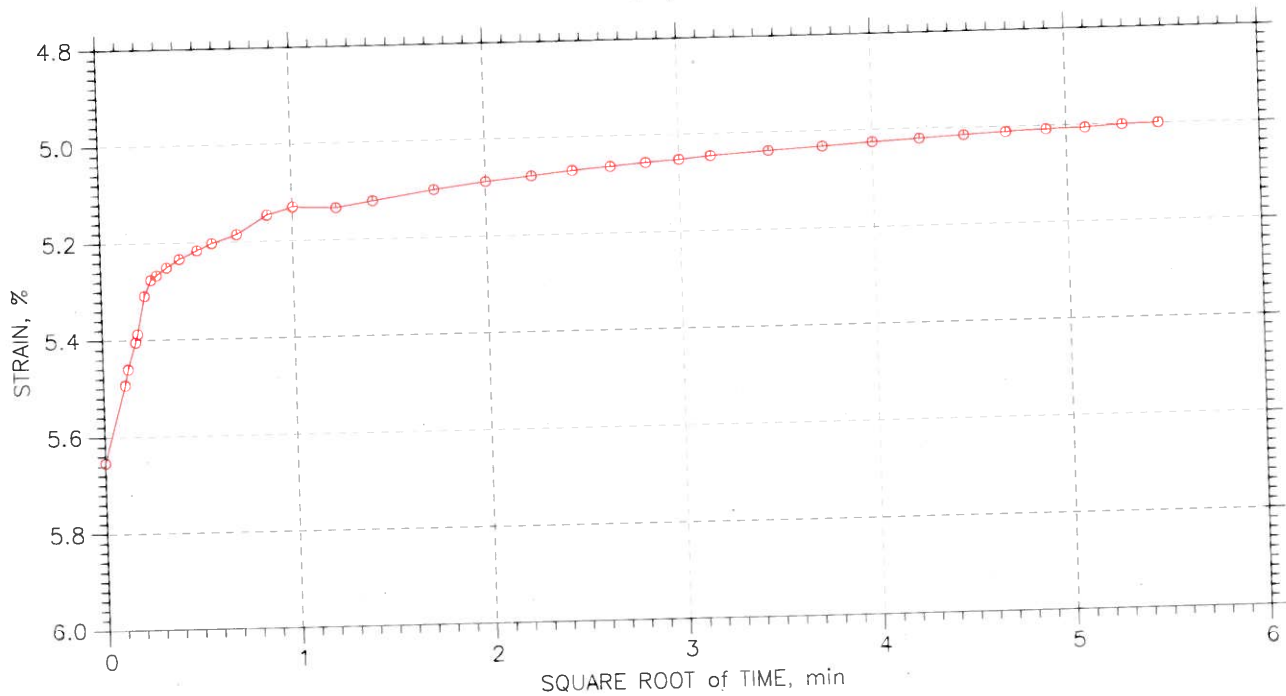
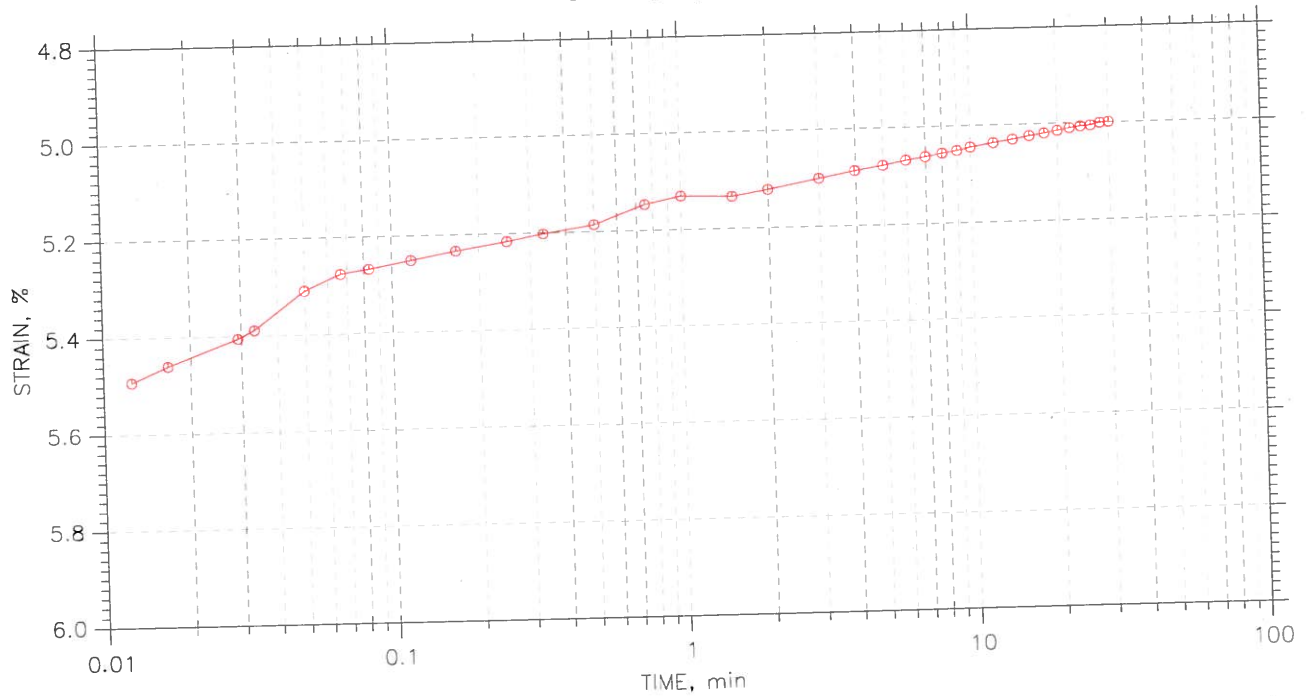
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-005	Test Date: 10-24-07	Depth: 10-12 ft
	Test No.: 21675	Sample Type: UD	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 8

Stress: 0.25 tsf



GeoTesting
express
the groundwork for success

Project: Lagoon Stabilization

Location: ---

Project No.: GTX-1304

Boring No.: ---

Tested By: mm

Checked By: ca

Sample No.: 0229-005

Test Date: 10-24-07

Depth: 10-12 ft

Test No.: 21675

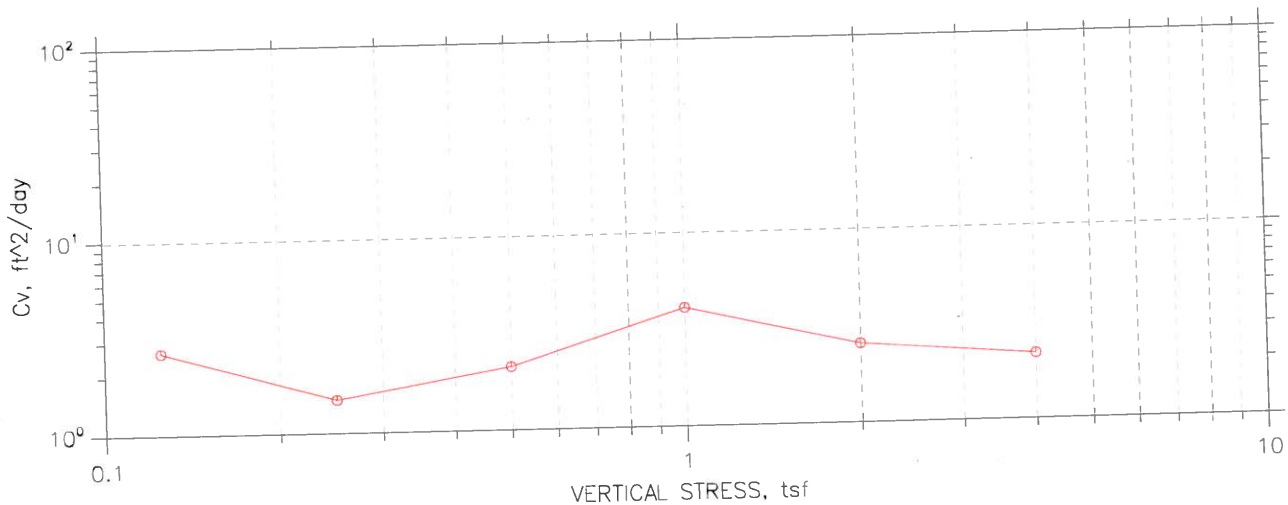
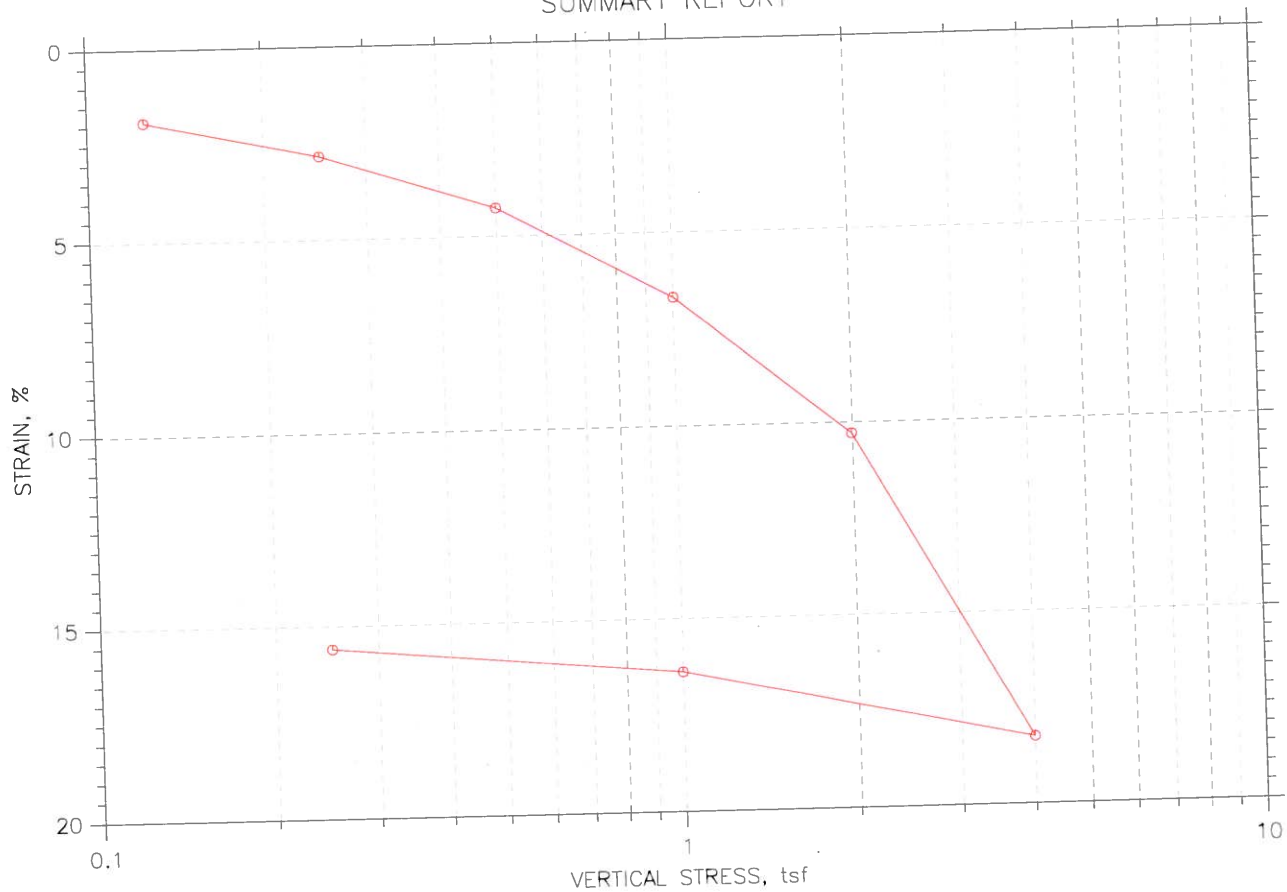
Sample Type: UD

Elevation: ---

Description: Stabilized Soil

Remarks: System 5077

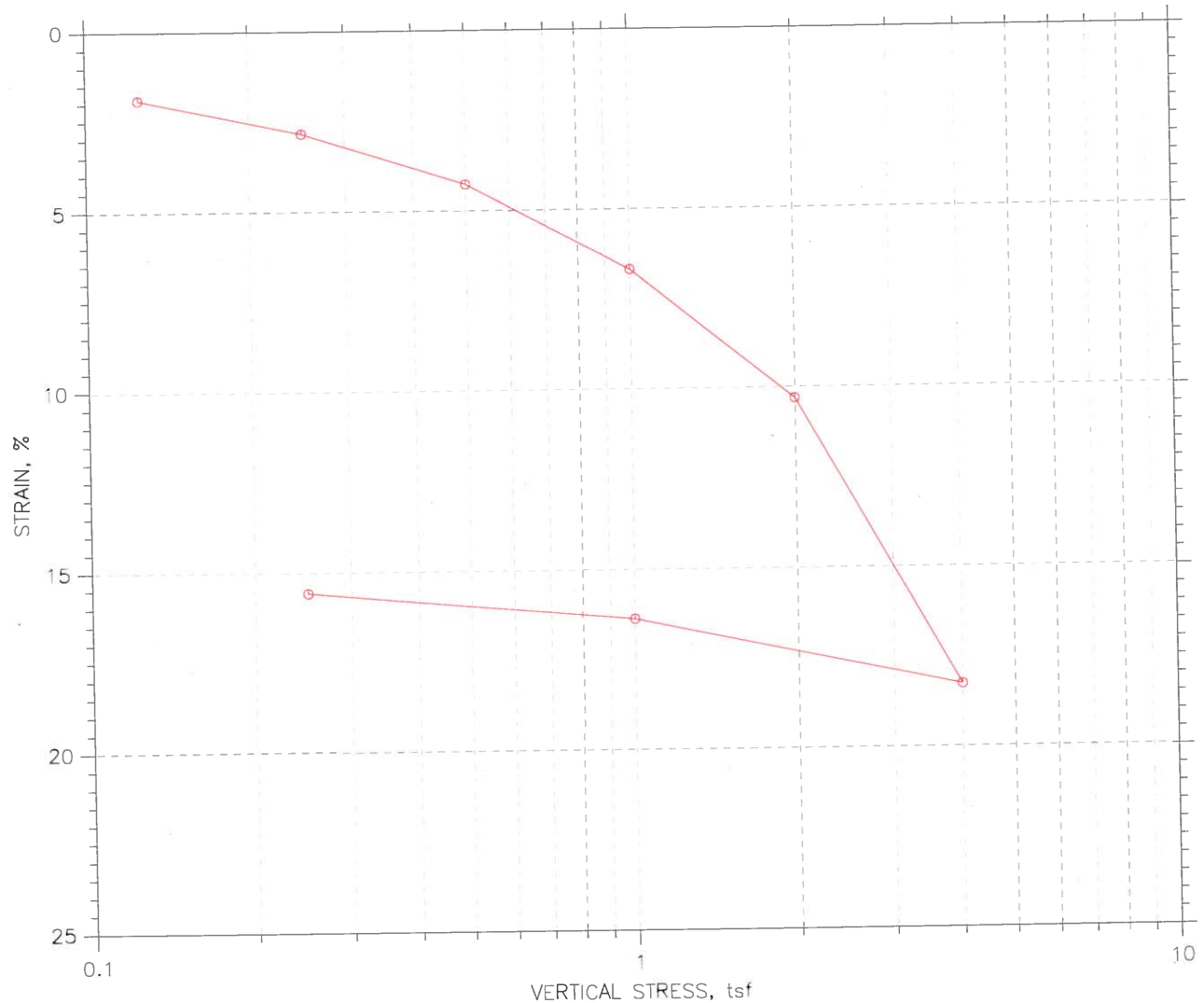
CONSOLIDATION TEST DATA SUMMARY REPORT



GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 tsf				158.77	126.92
Preconsolidation Pressure: 0 tsf				30.48	36.11
Compression Index: 0				95.43	94.40
Diameter: 2.5 in		Height: 1 in		4.33	3.50
LL: NP	PL: NP	PI: NP	GS: 2.60		

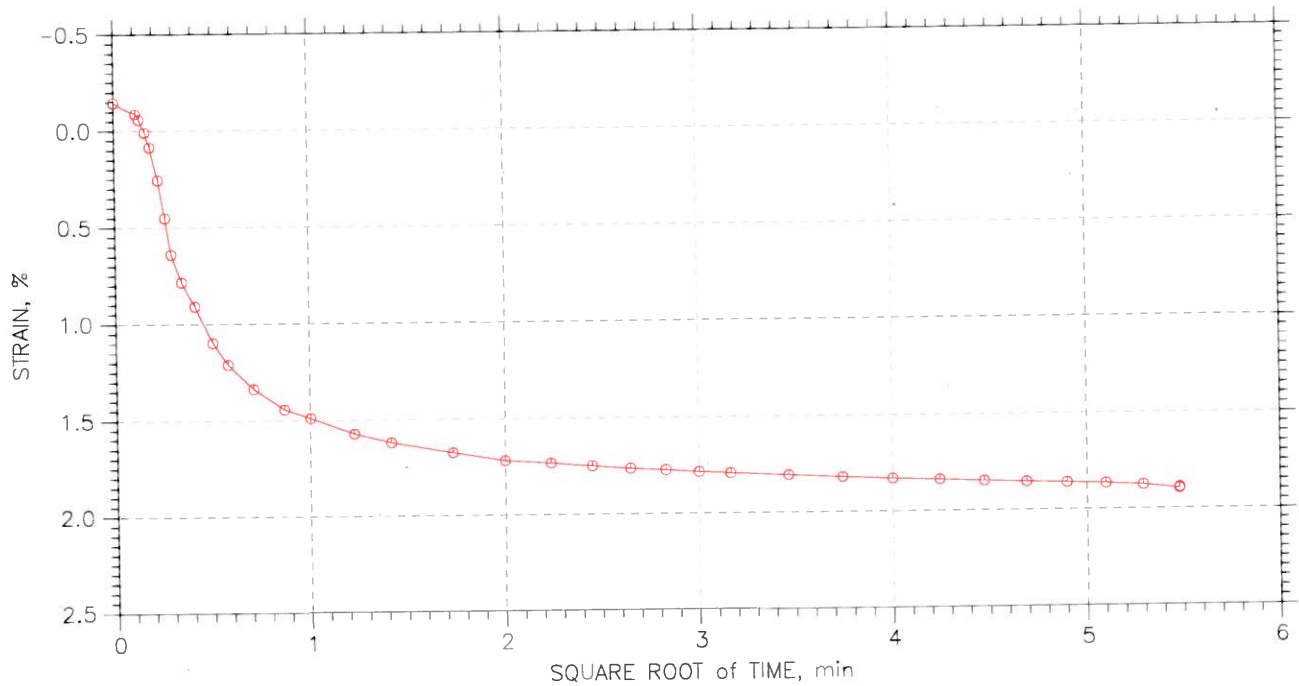
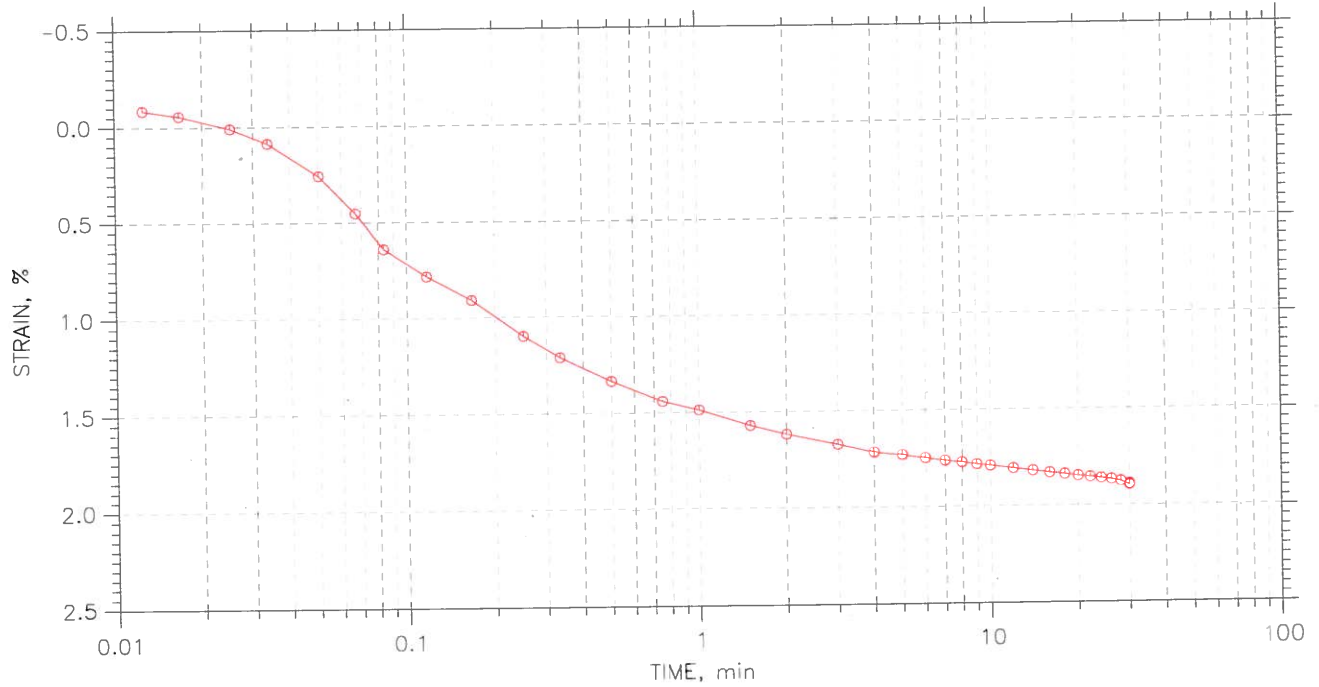
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 8

Stress: 0.125 tsf



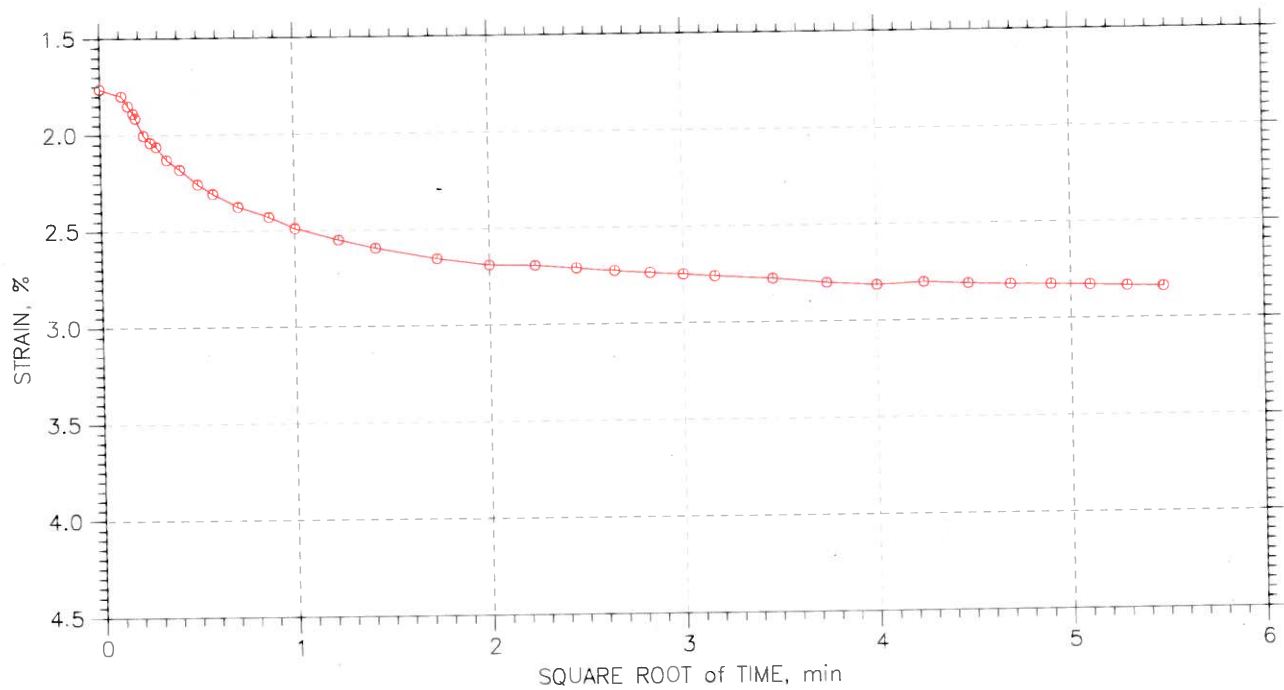
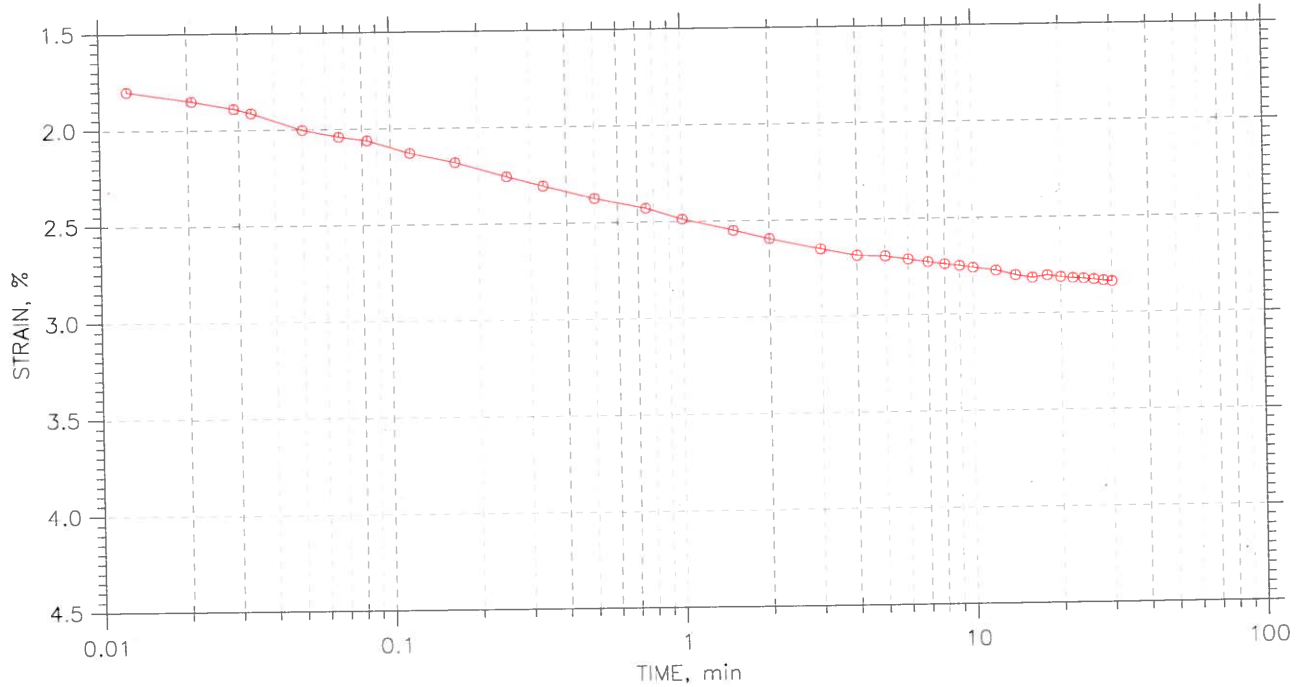
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 8

Stress: 0.25 tsf



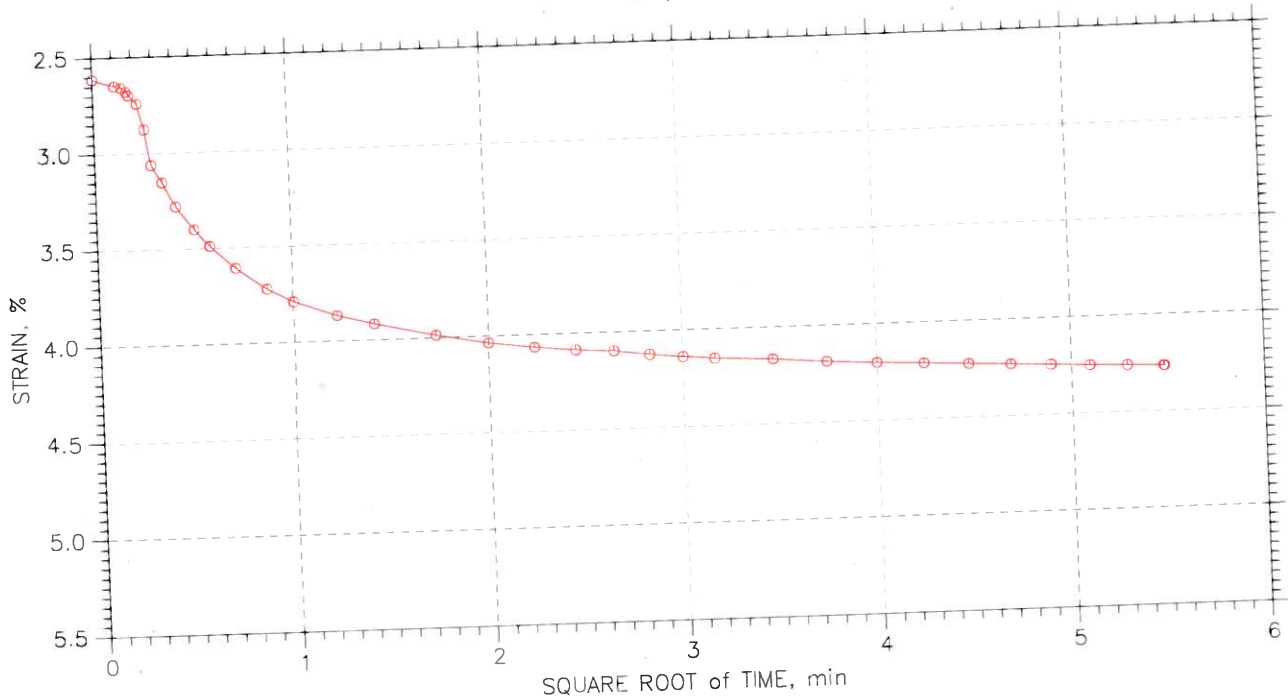
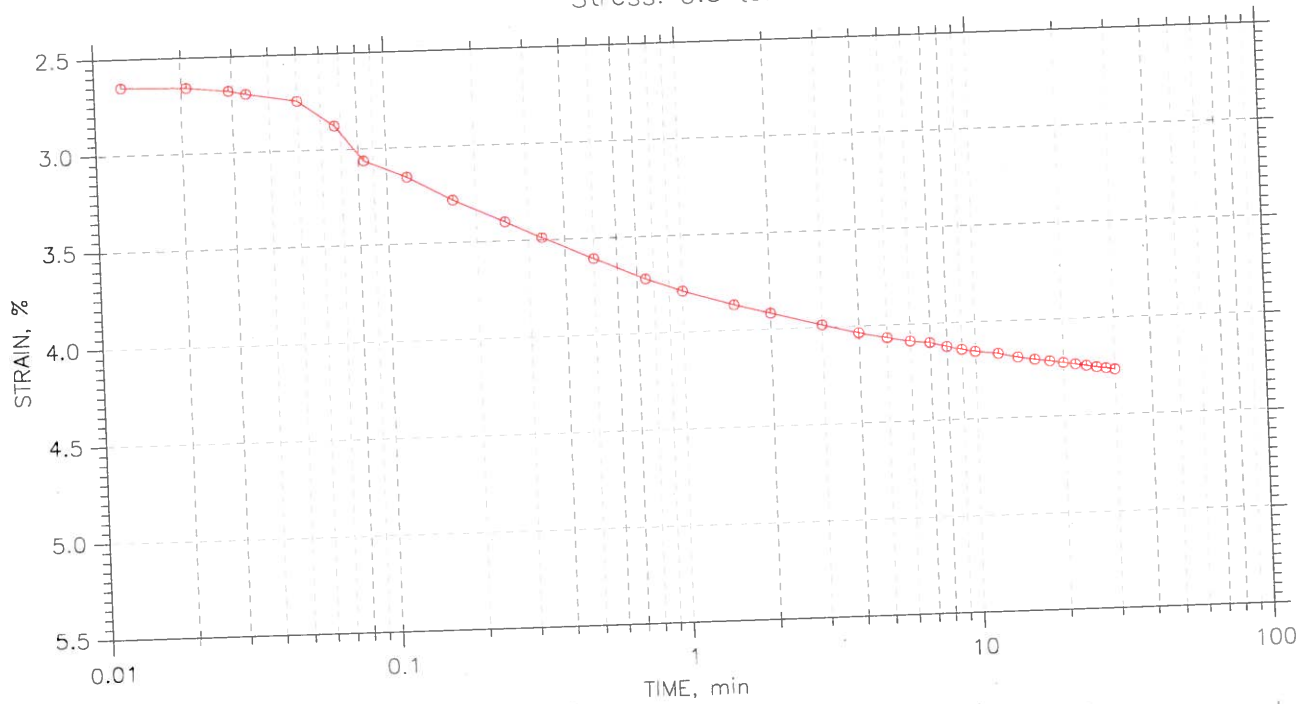
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 8

Stress: 0.5 tsf



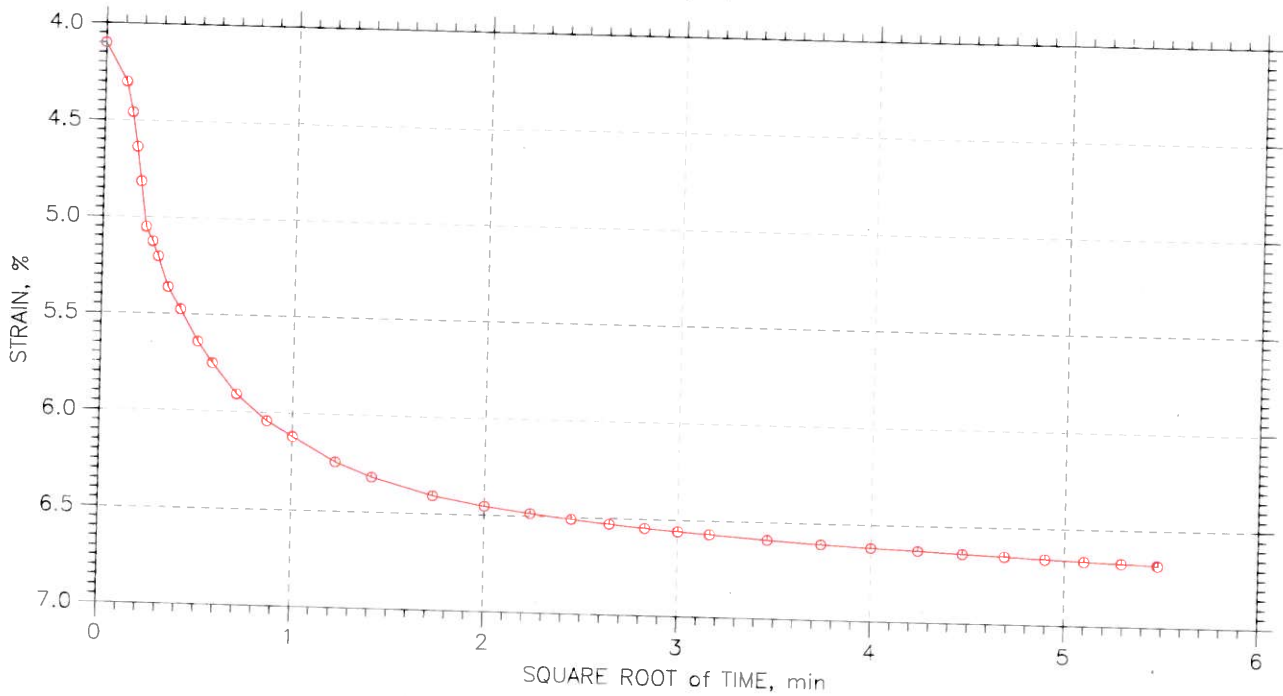
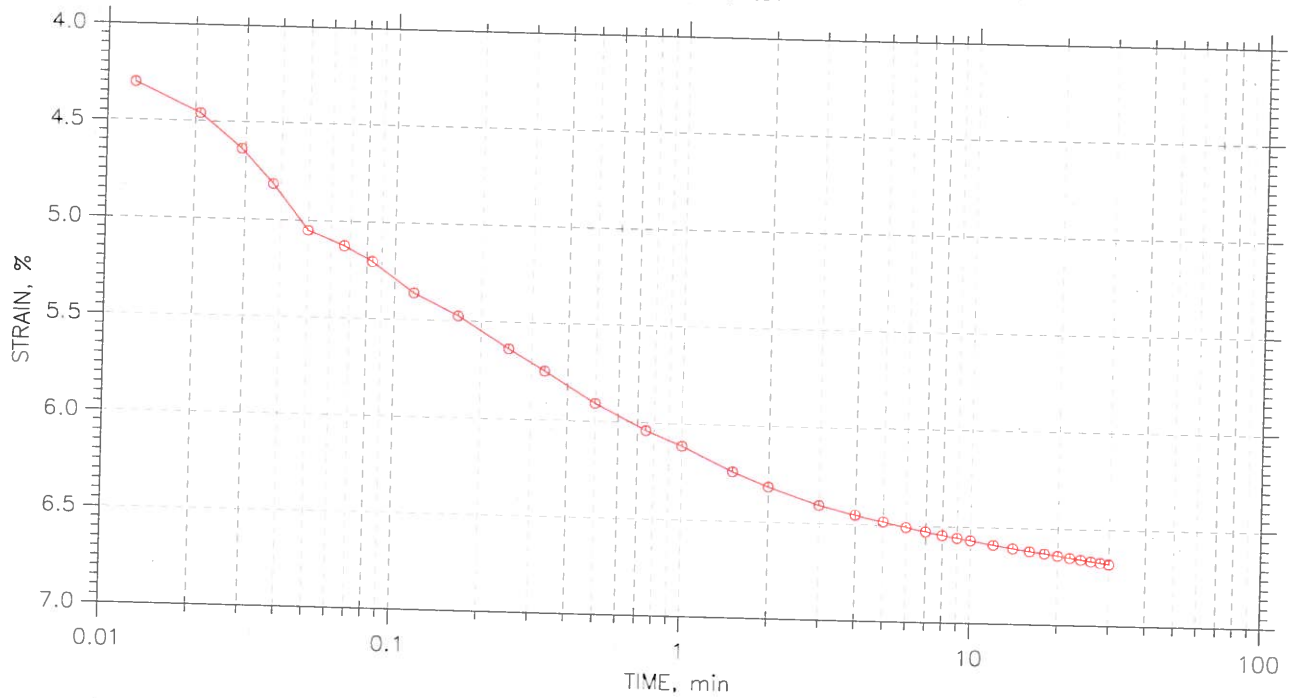
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 8

Stress: 1. tsf



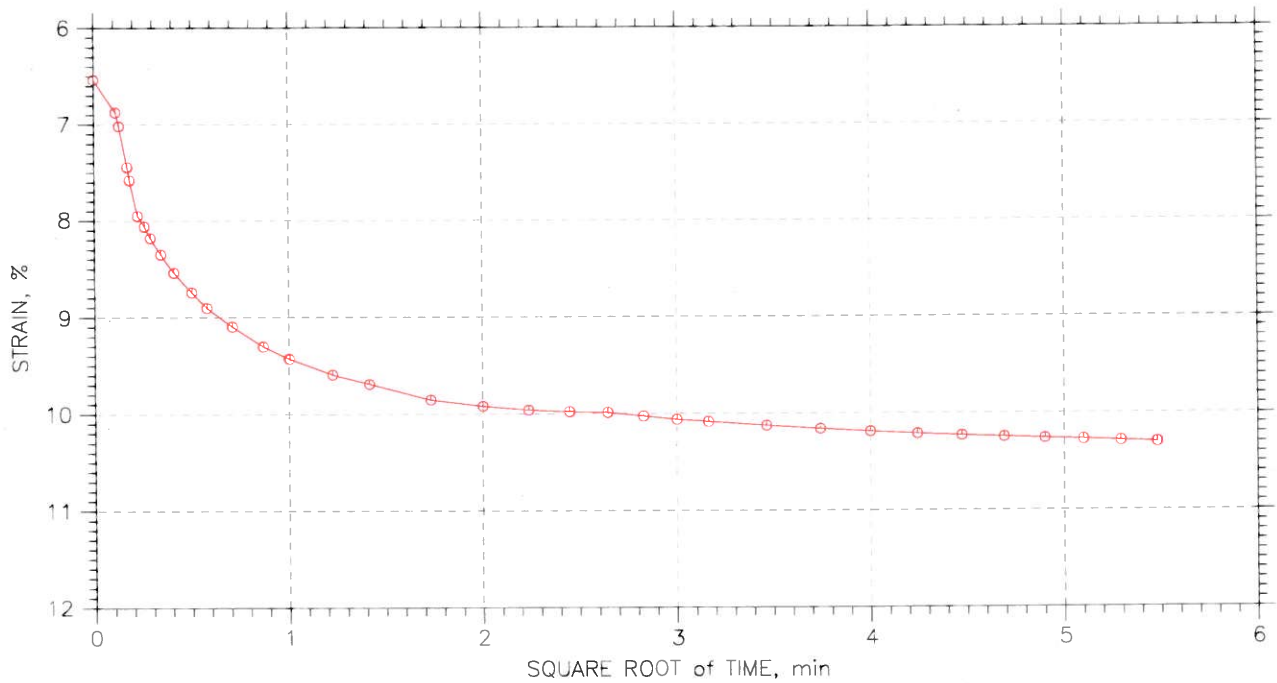
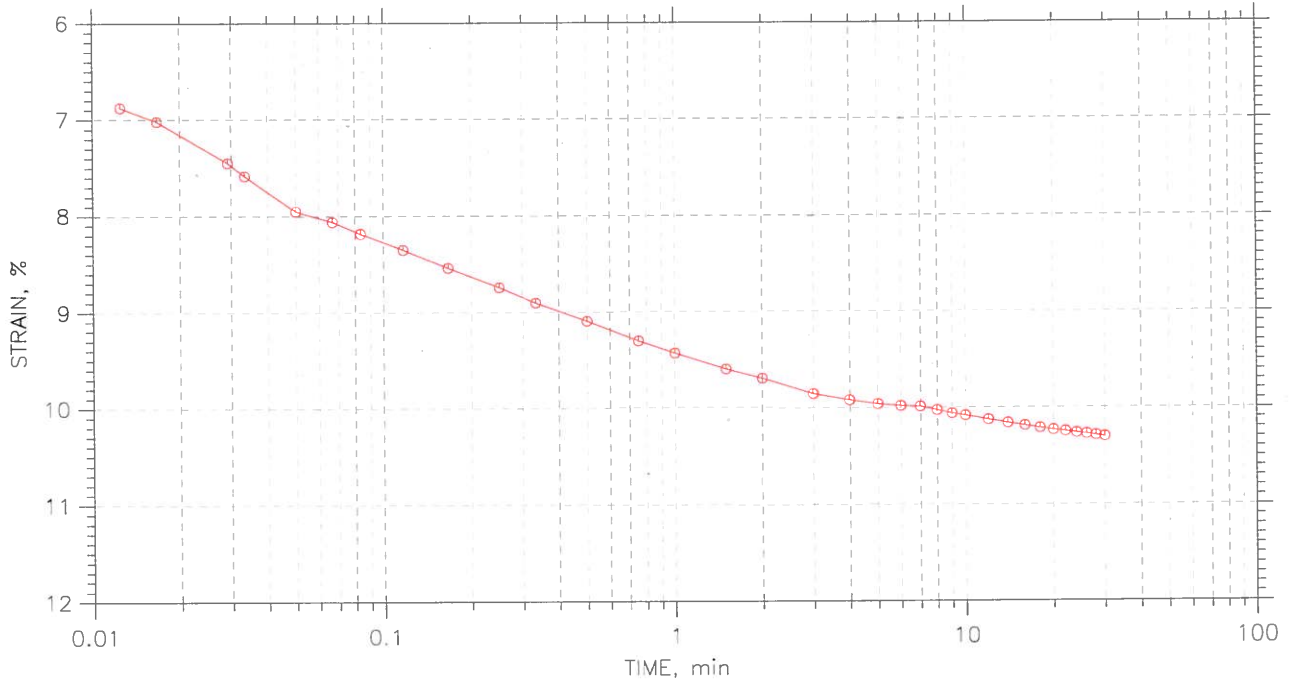
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 8

Stress: 2. tsf



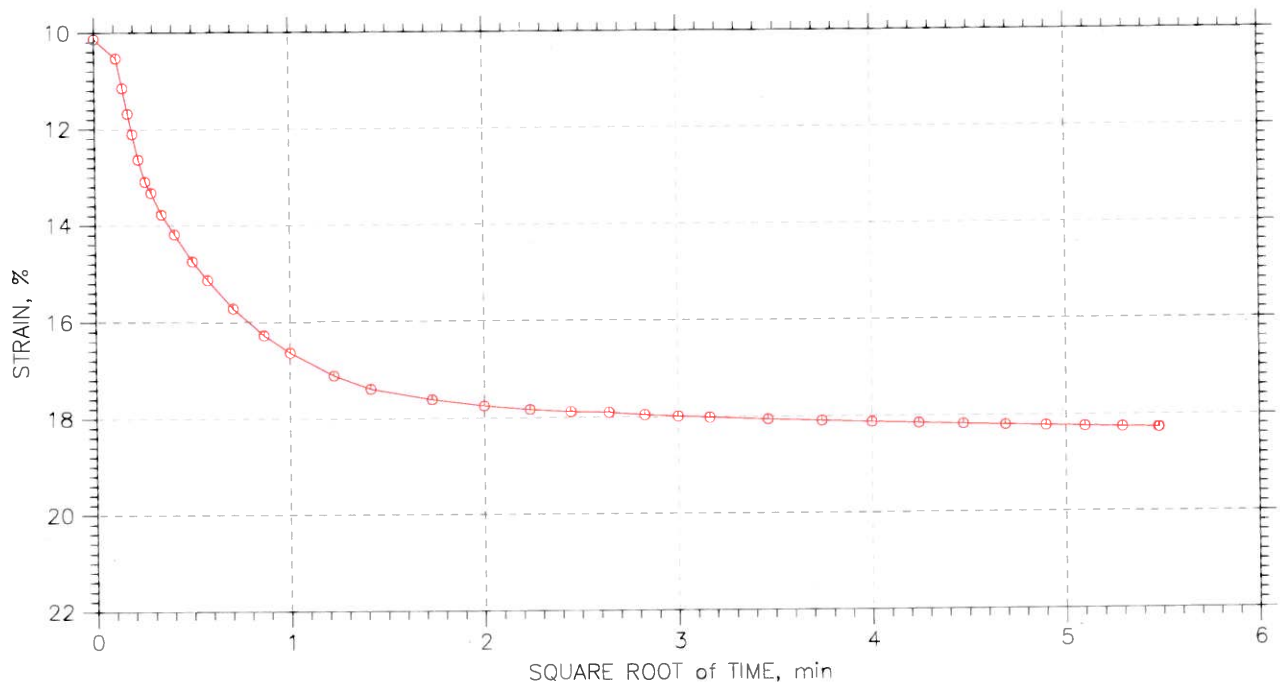
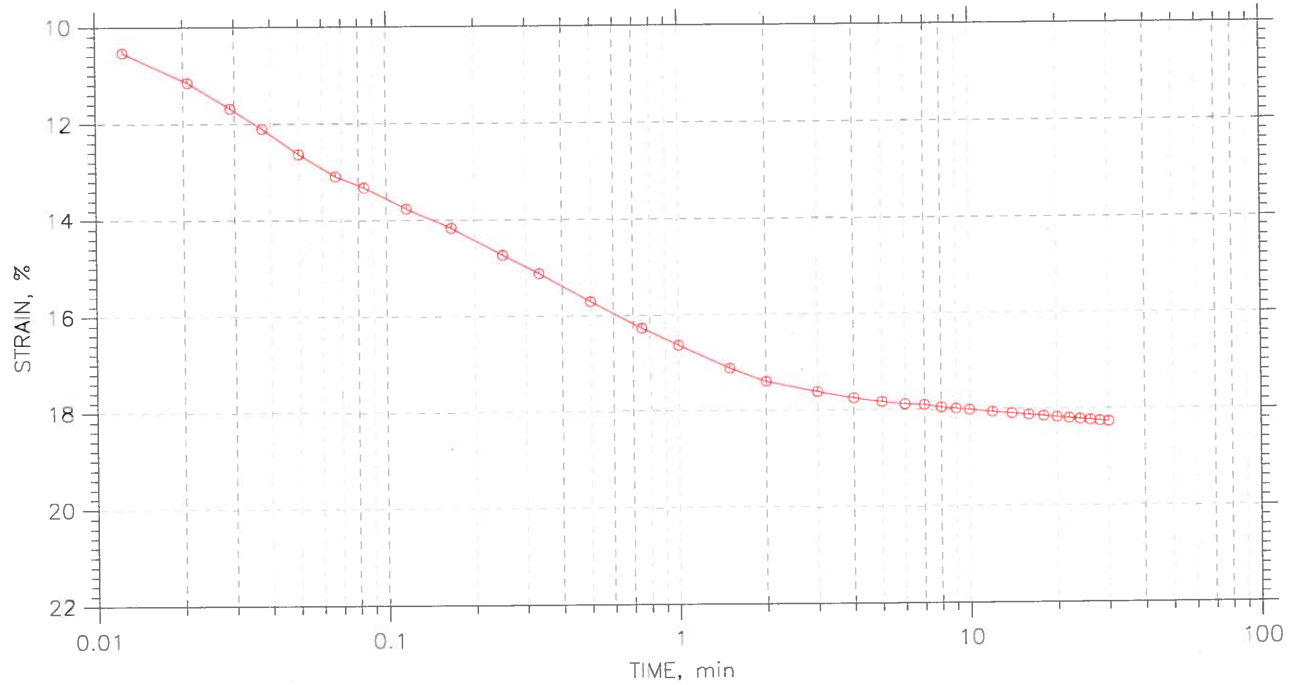
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 8

Stress: 4. tsf



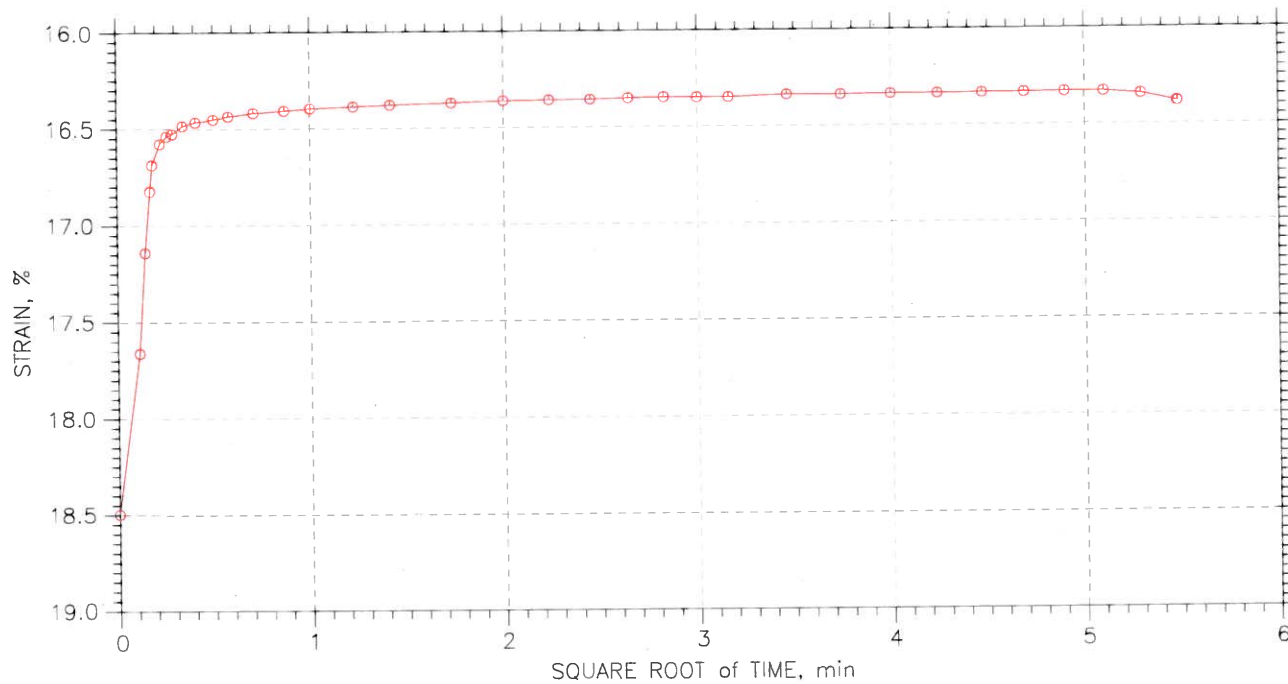
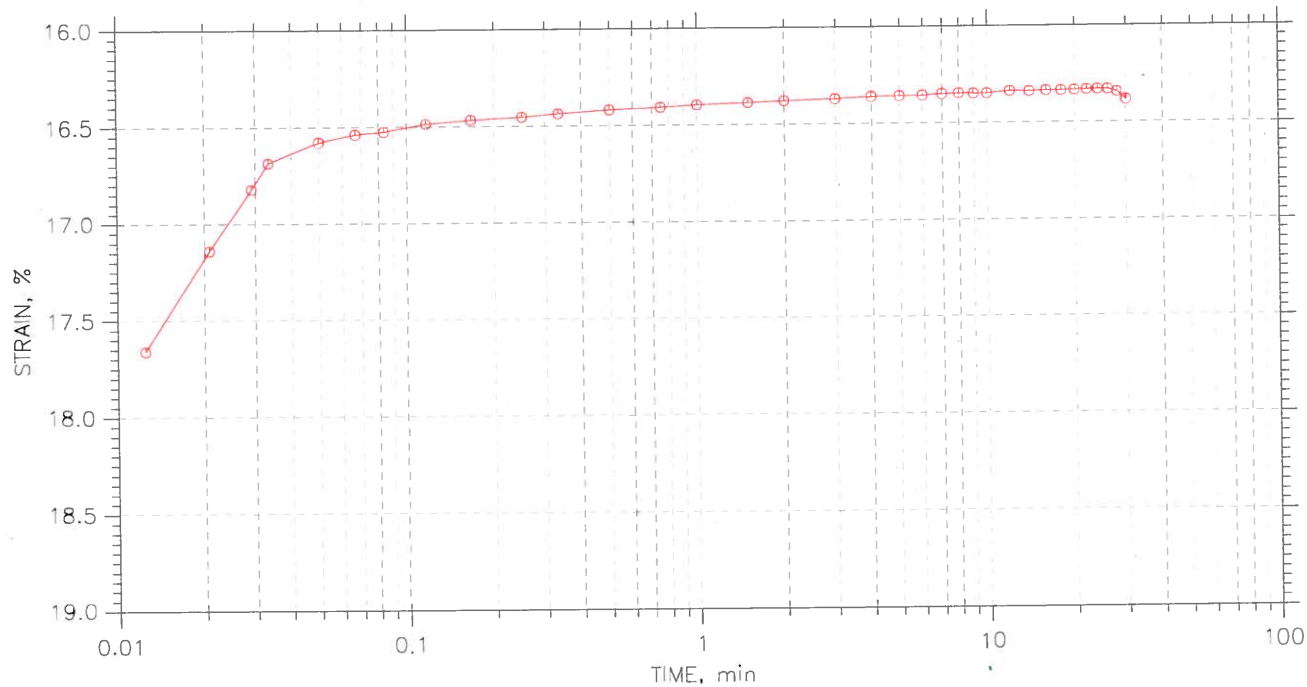
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 8

Stress: 1. tsf



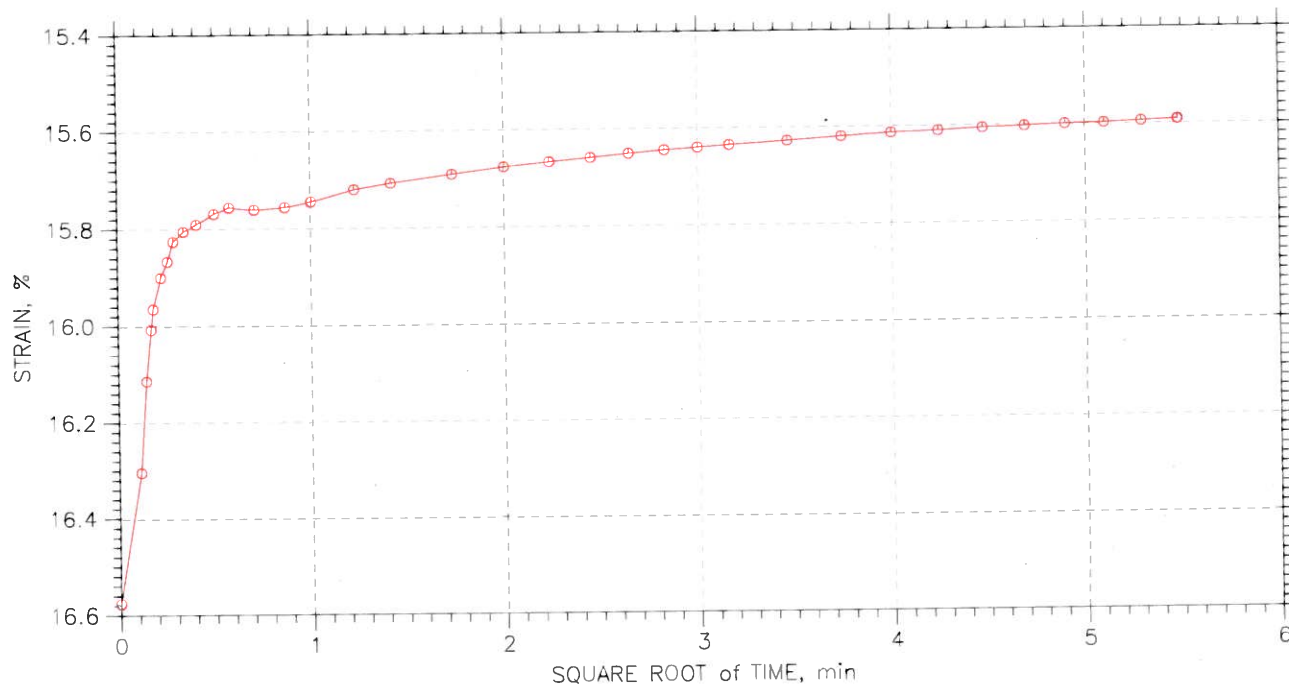
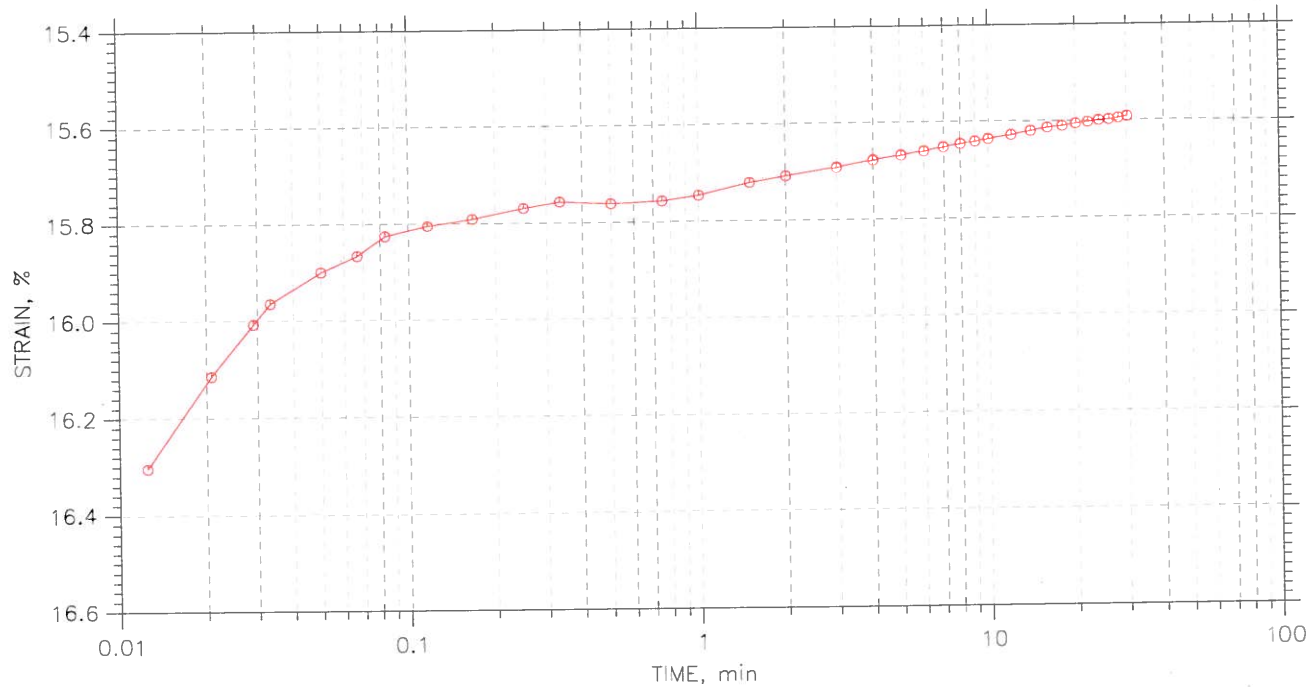
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 8

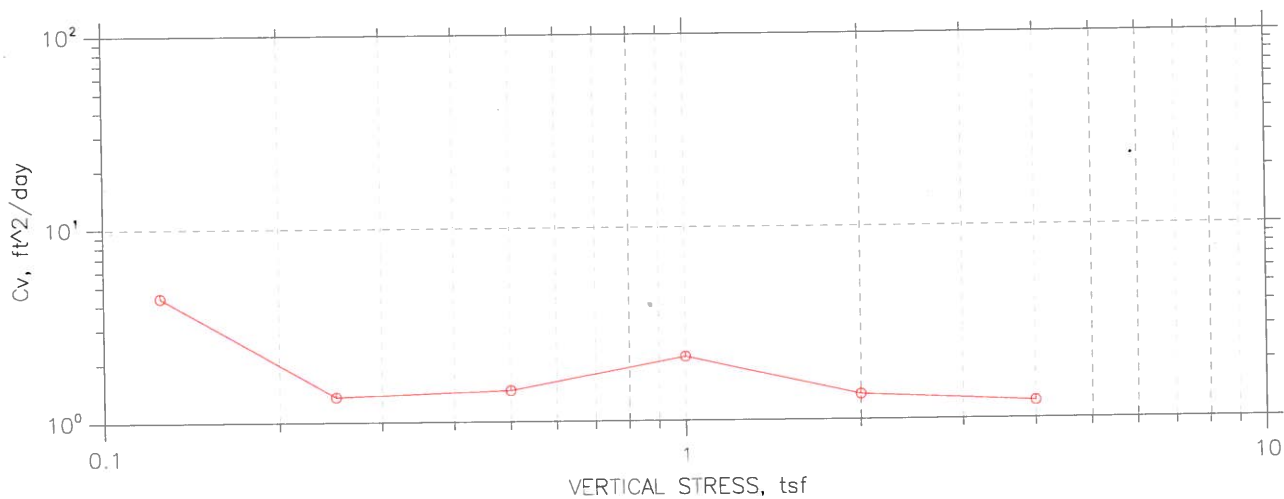
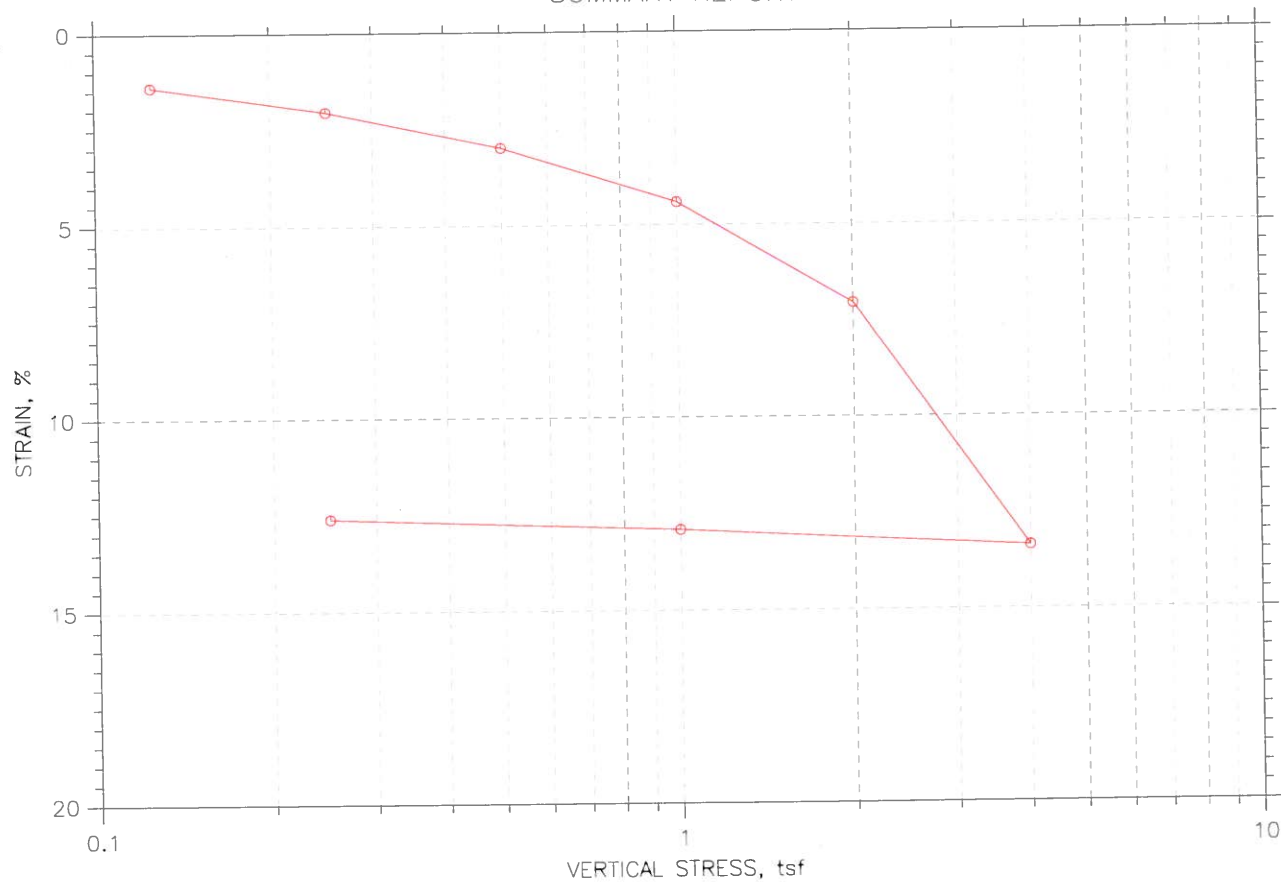
Stress: 0.25 tsf



GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-013	Test Date: 10-24-07	Depth: ---
	Test No.: 21676	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

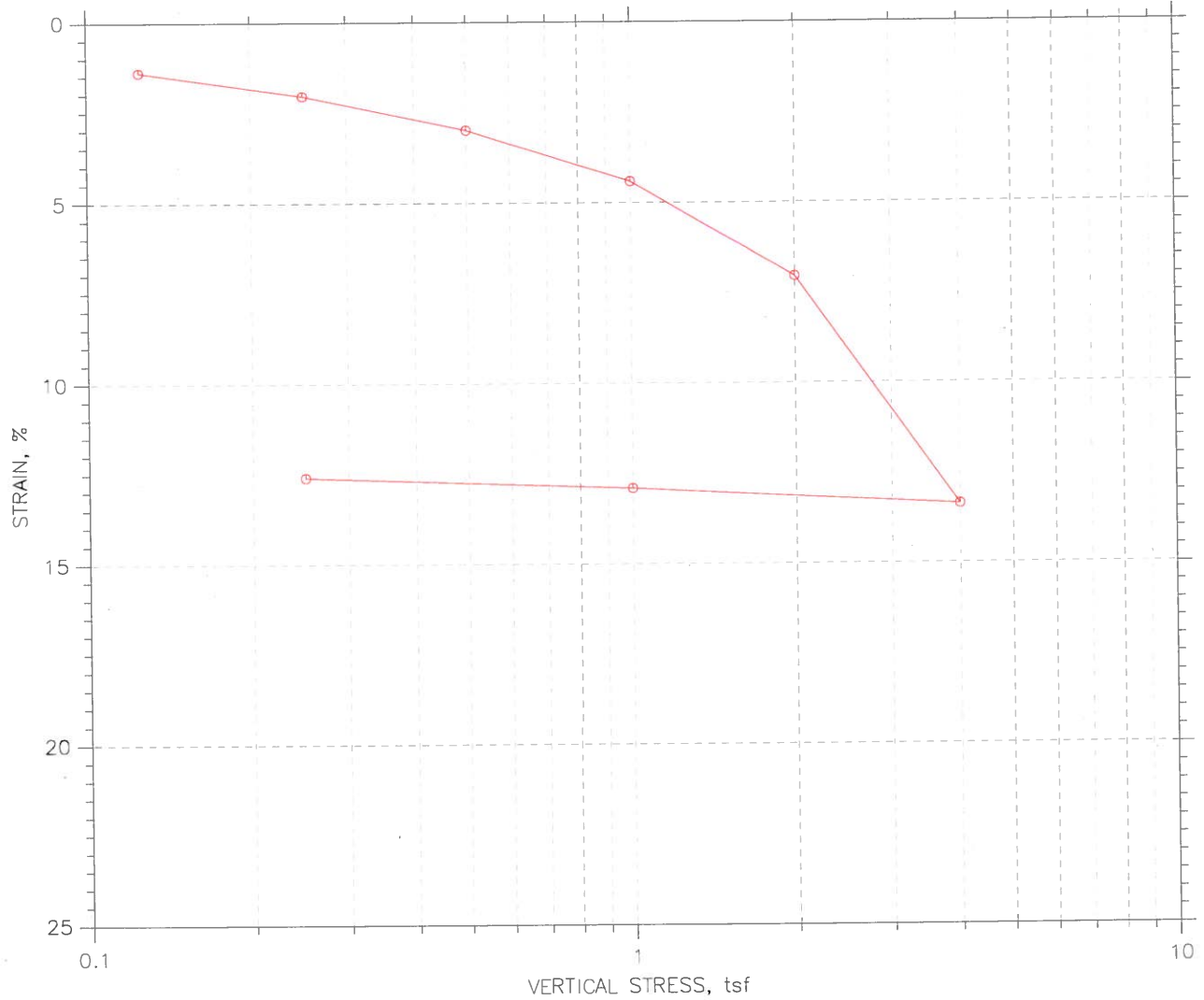
CONSOLIDATION TEST DATA

SUMMARY REPORT



GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 tsf				Water Content, %	0.00
Preconsolidation Pressure: 0 tsf				Dry Unit Weight, pcf	.E-17
Compression Index: 0				Saturation, %	0.00
Diameter: 2.5 in		Height: 1.005 in		Void Ratio	0.00
LL: NP	PL: NP	PI: NP	GS: 0.00		

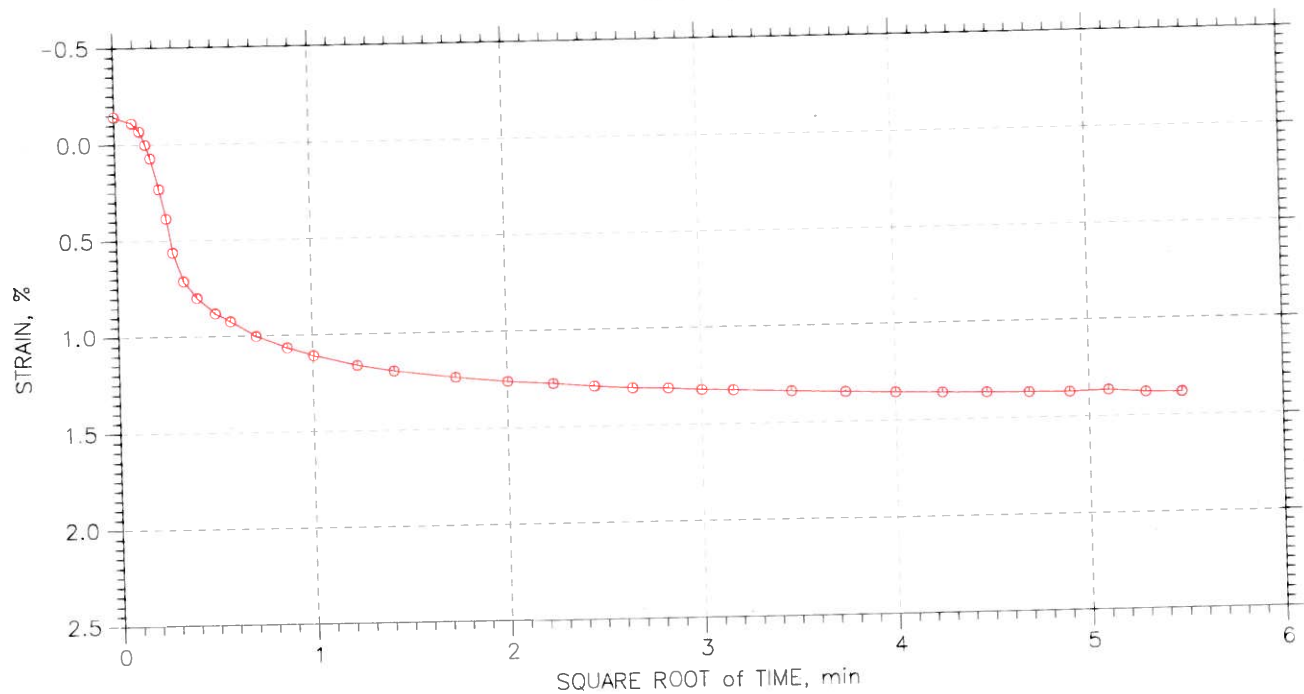
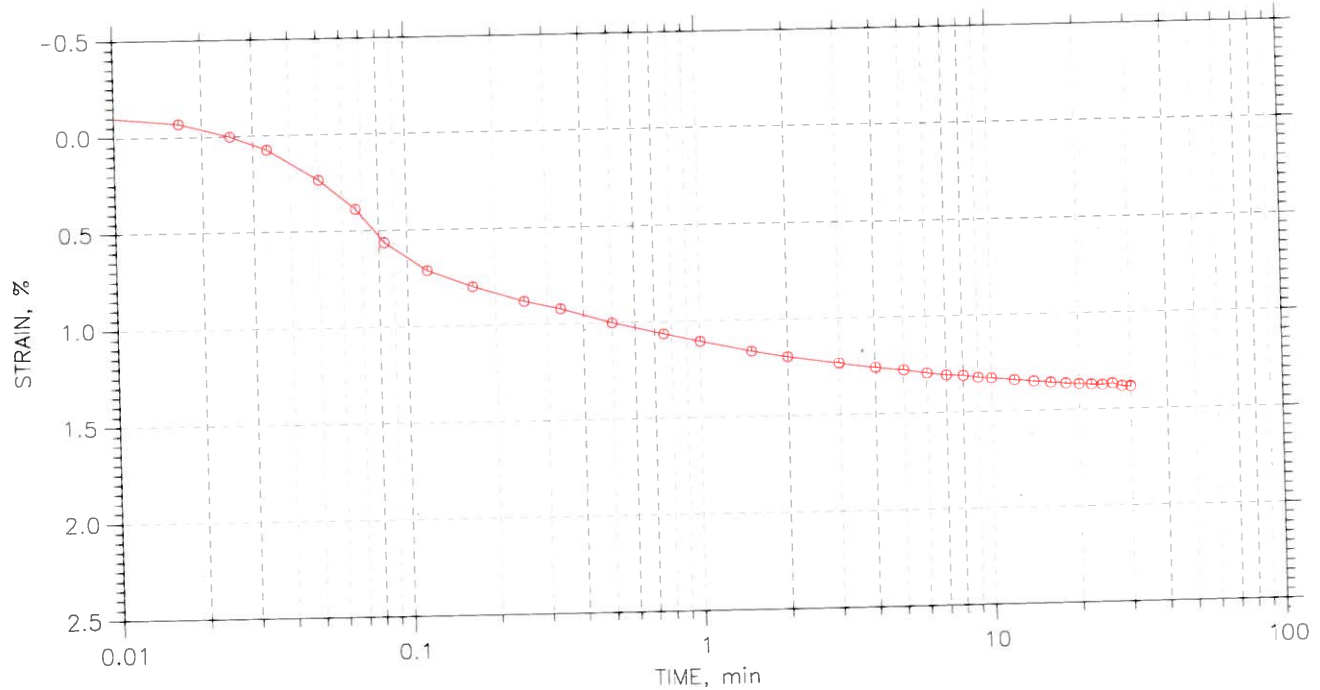
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 8

Stress: 0.125 tsf



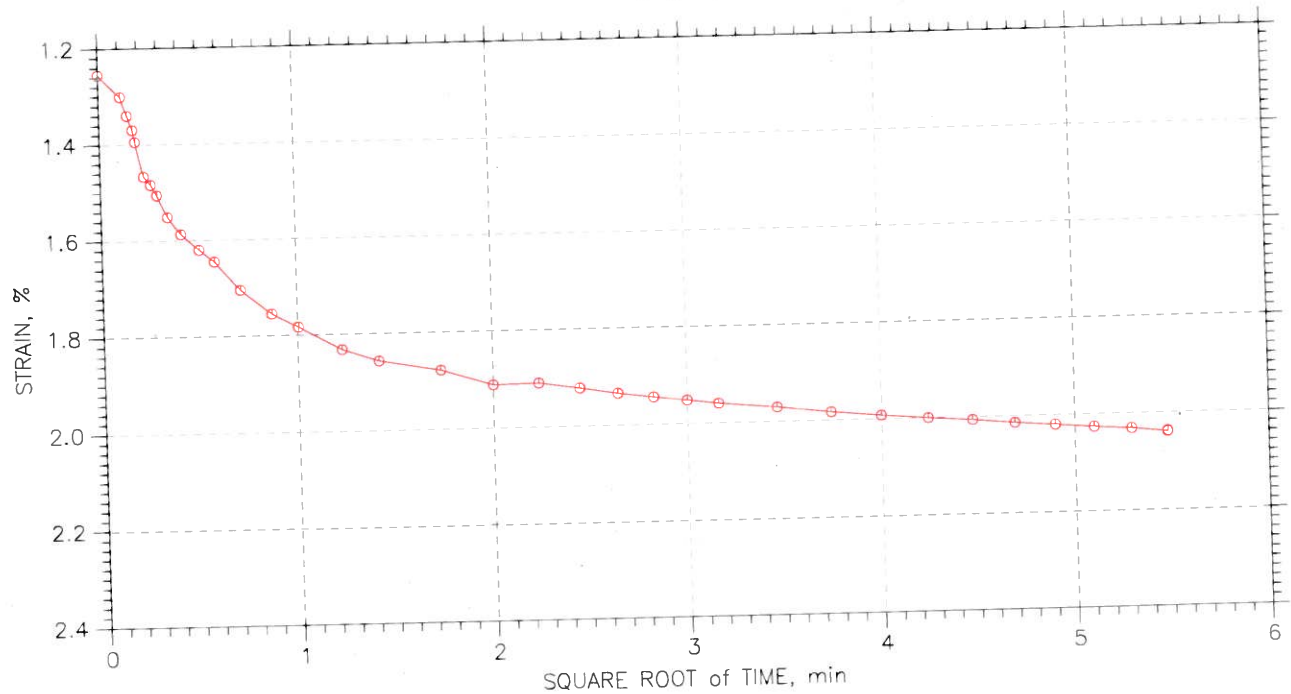
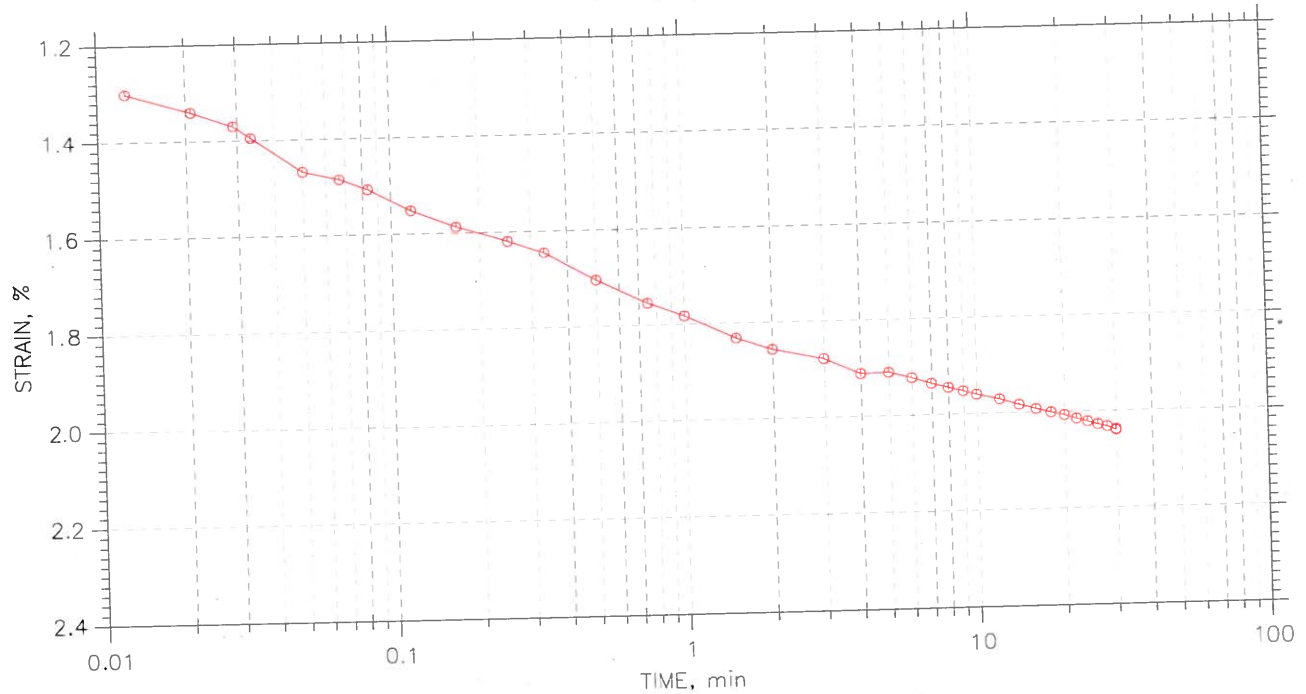
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 8

Stress: 0.25 tsf



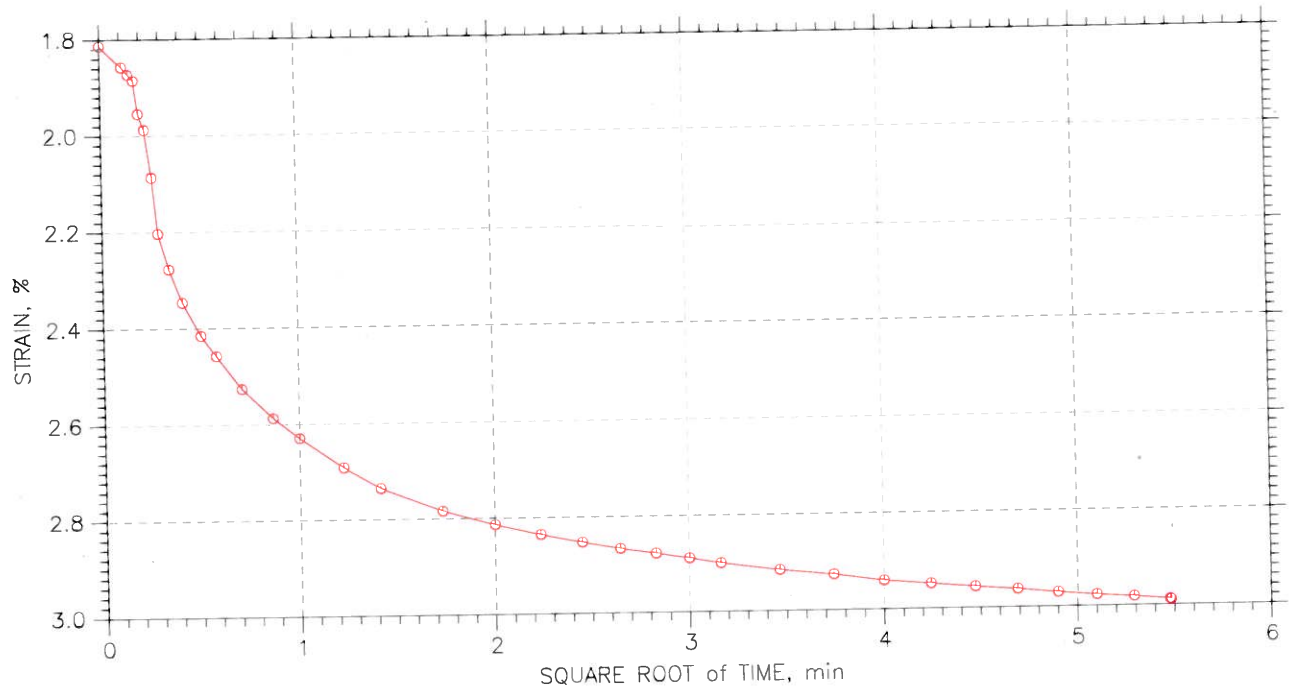
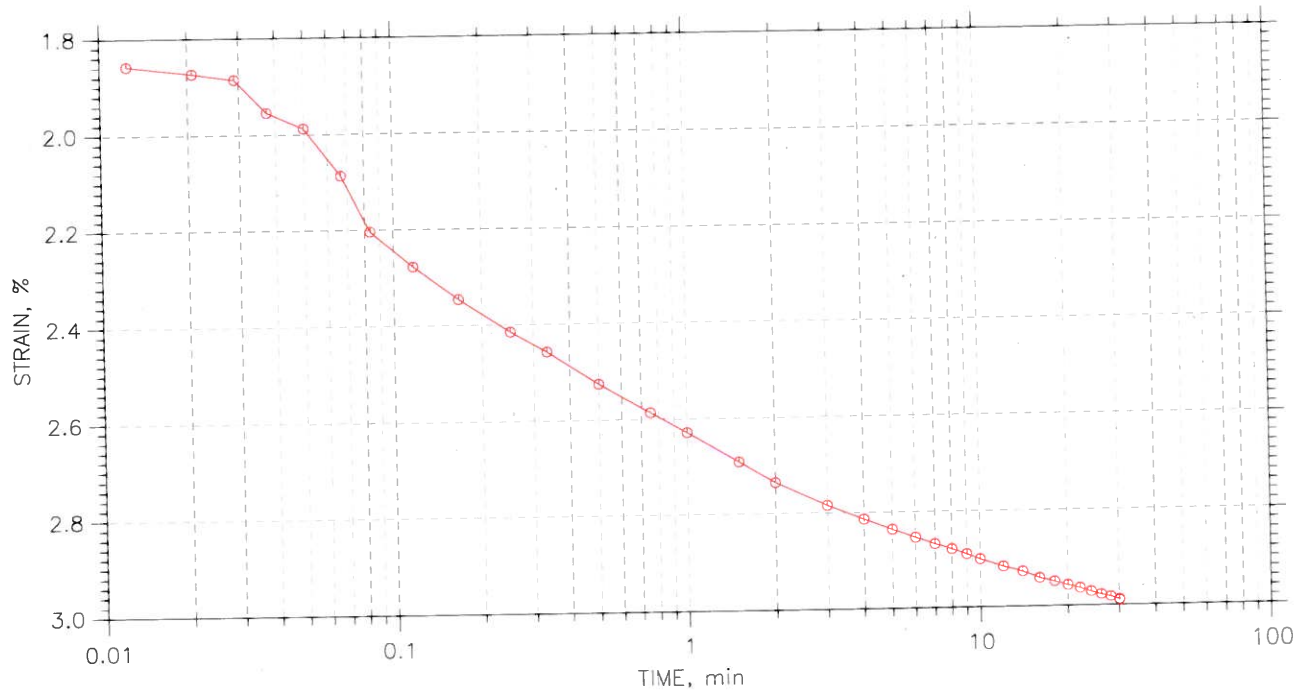
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 8

Stress: 0.5 tsf



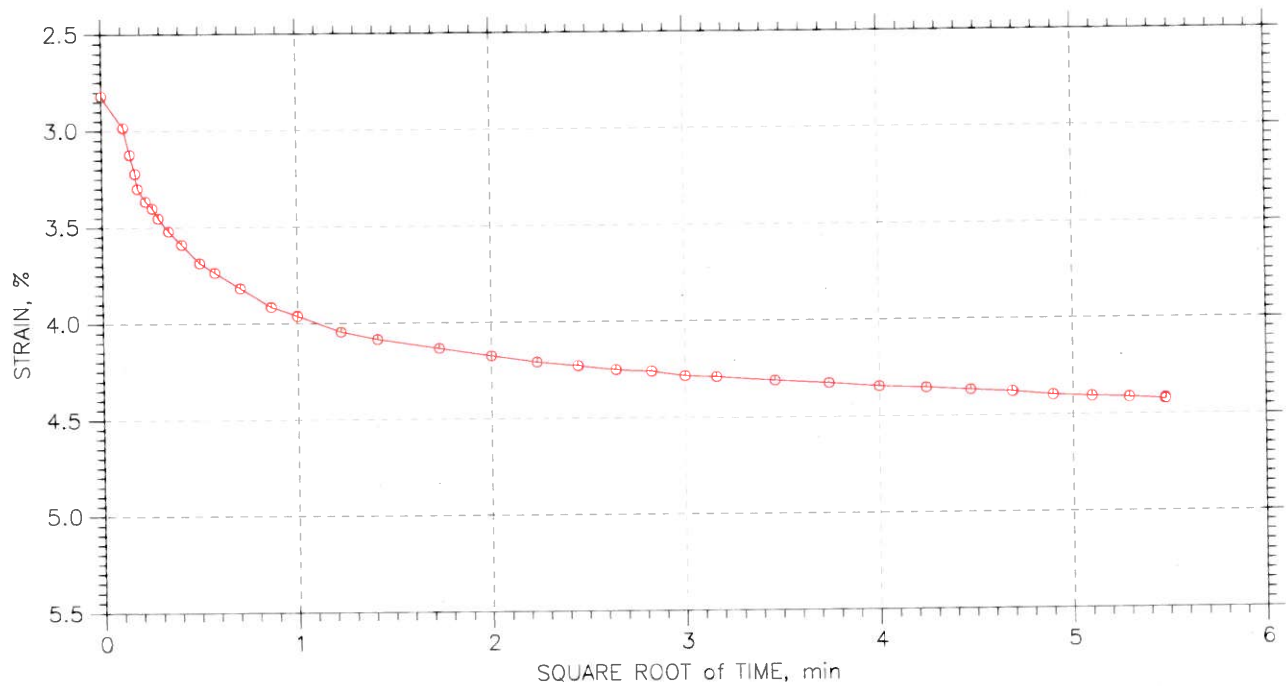
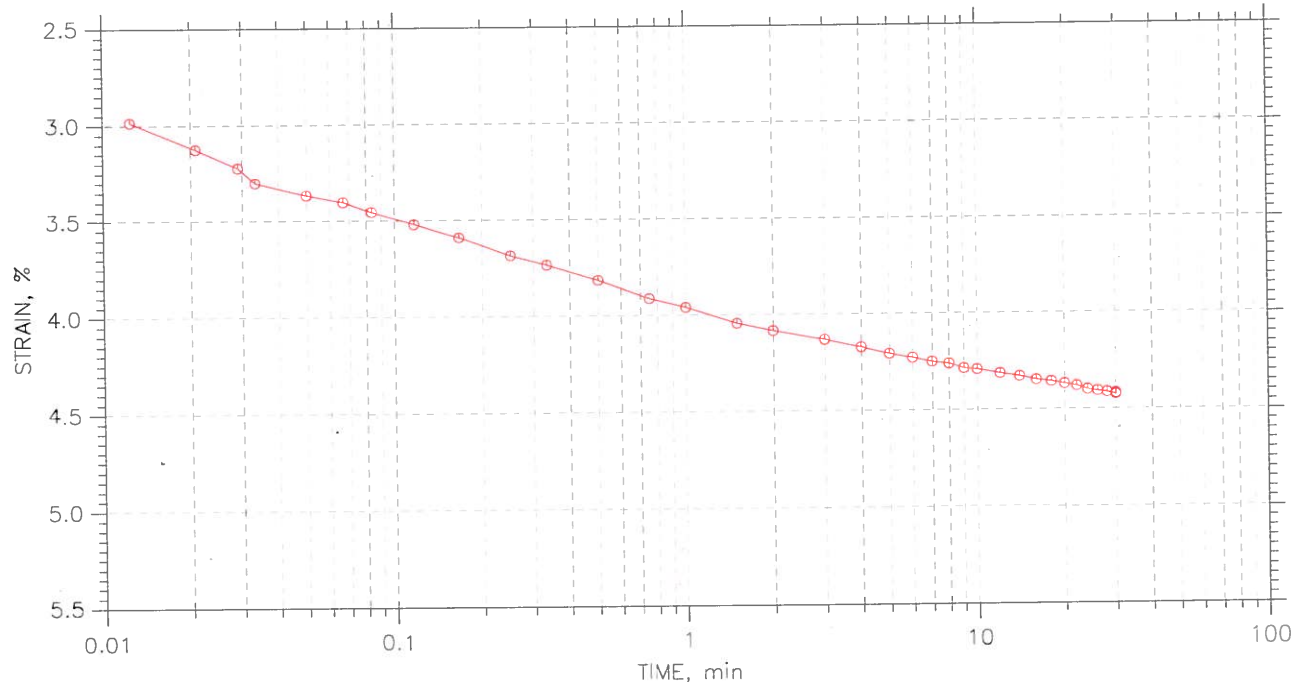
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 8

Stress: 1. tsf



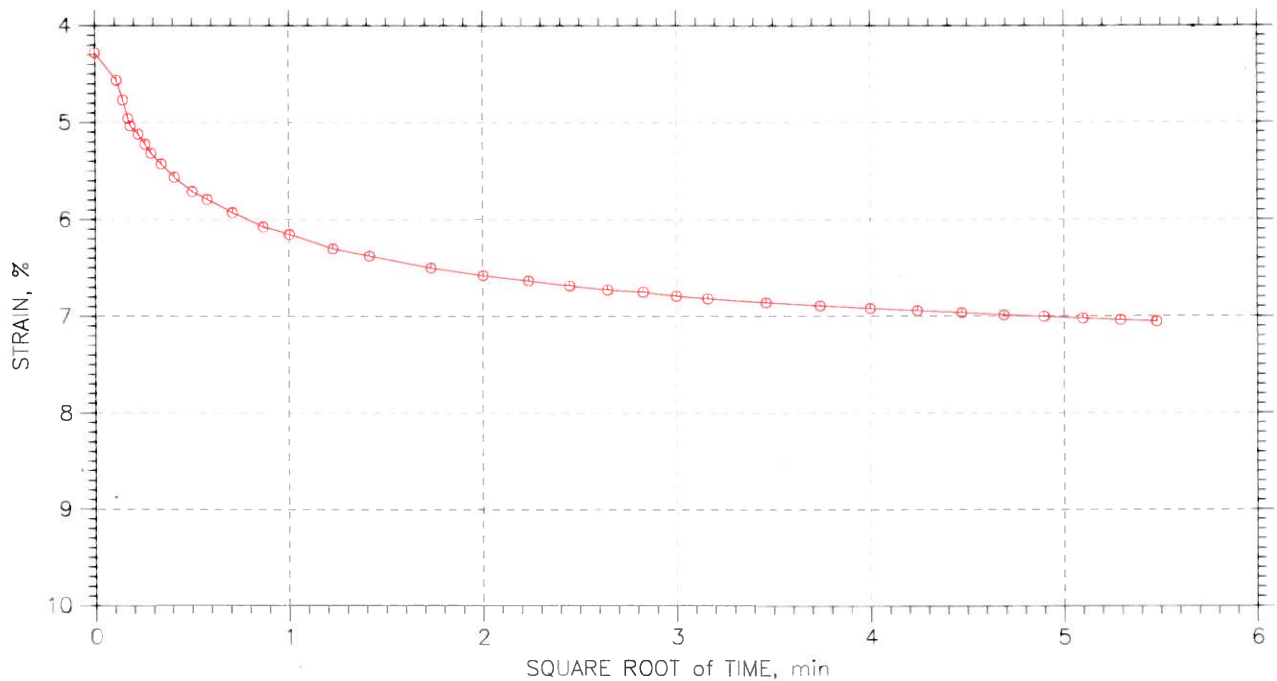
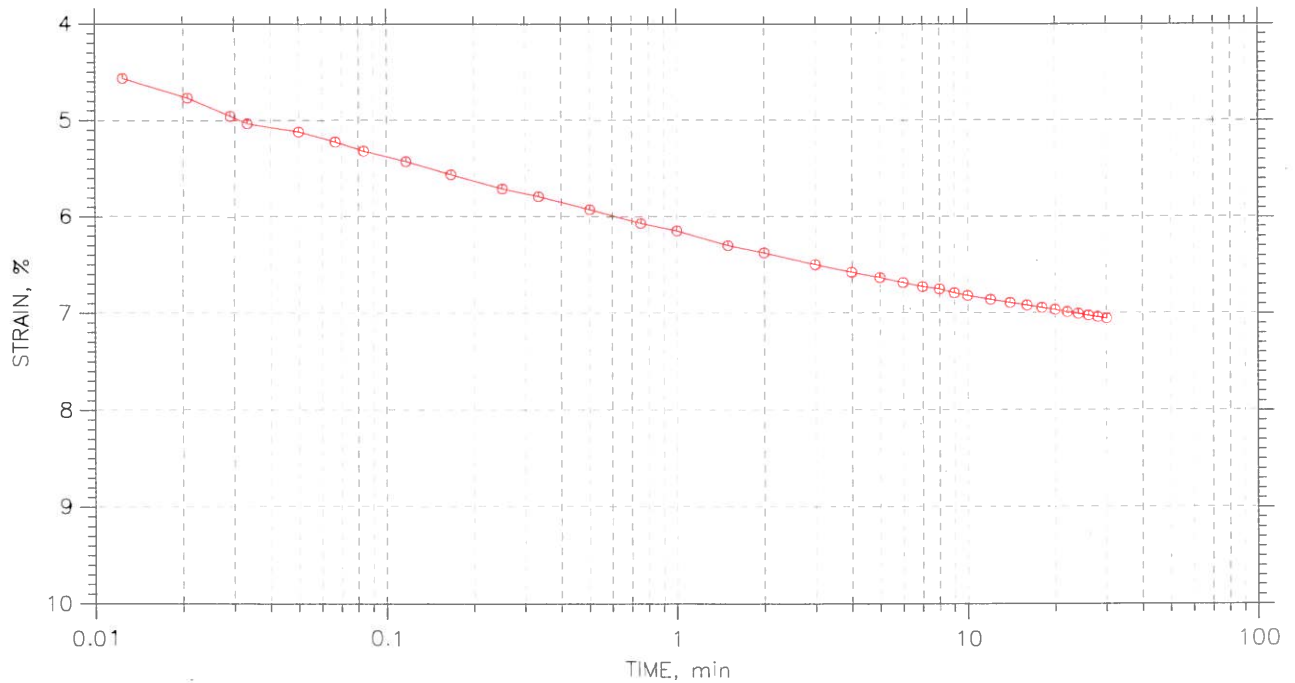
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 8

Stress: 2. tsf



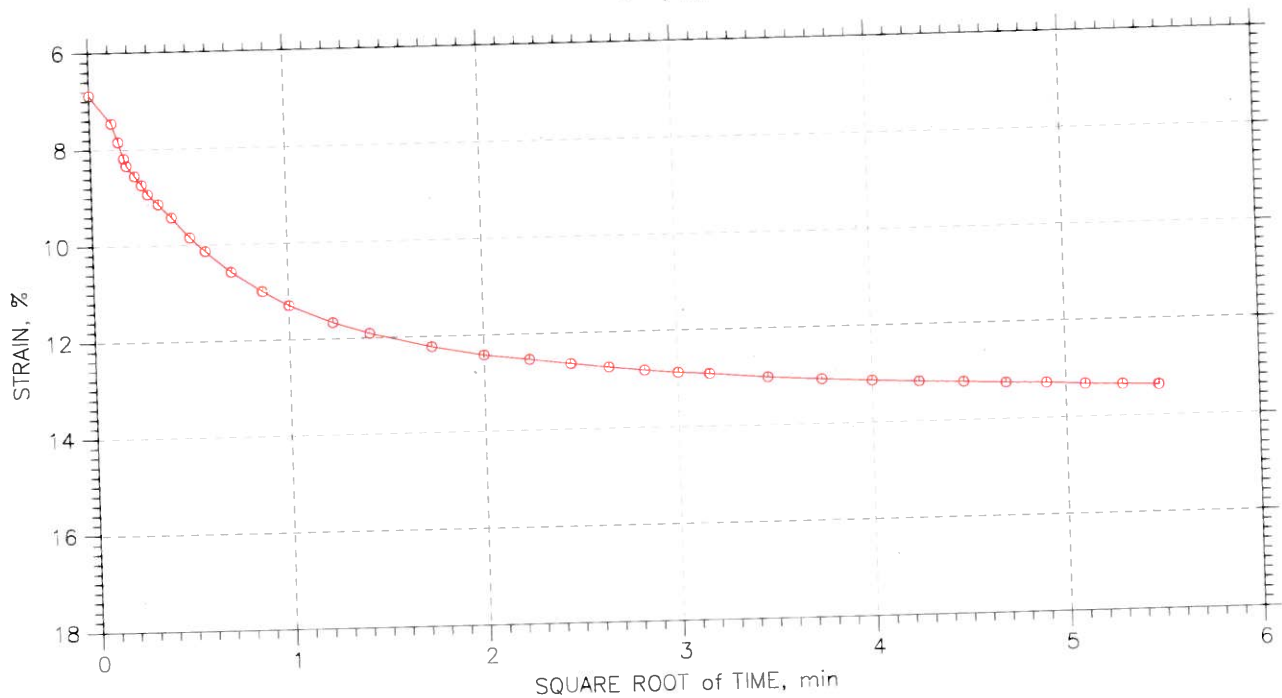
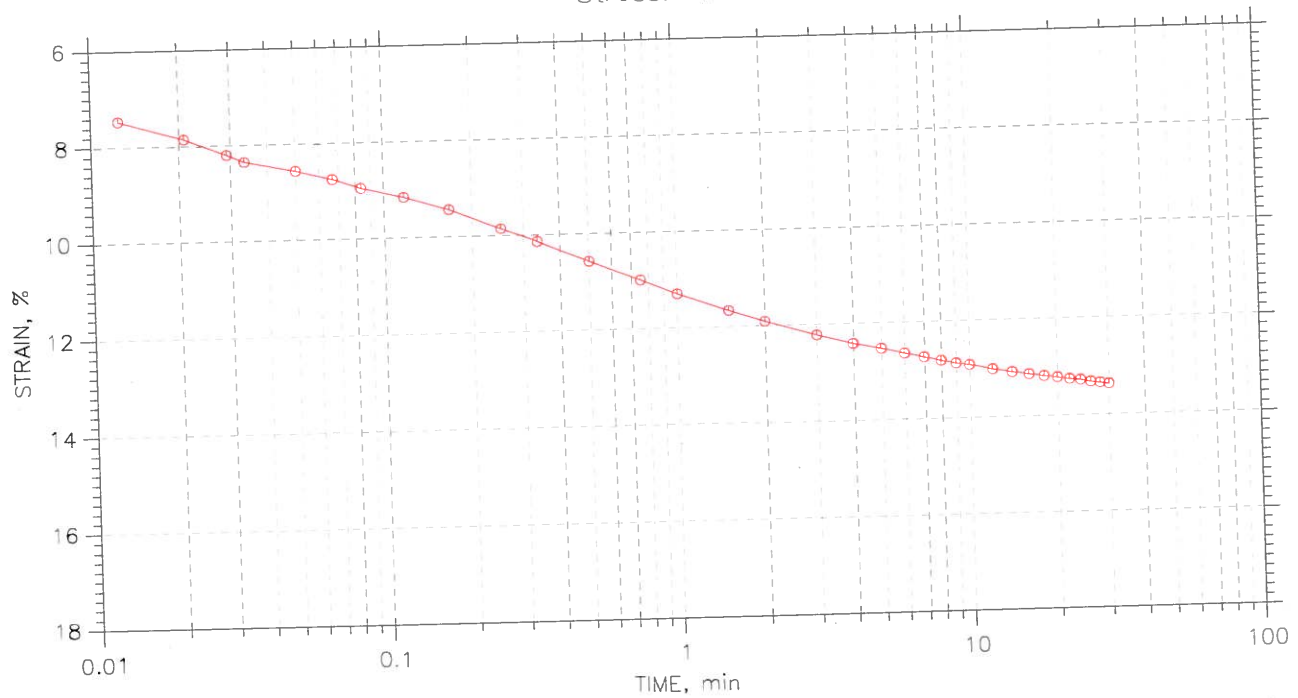
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 8

Stress: 4. tsf



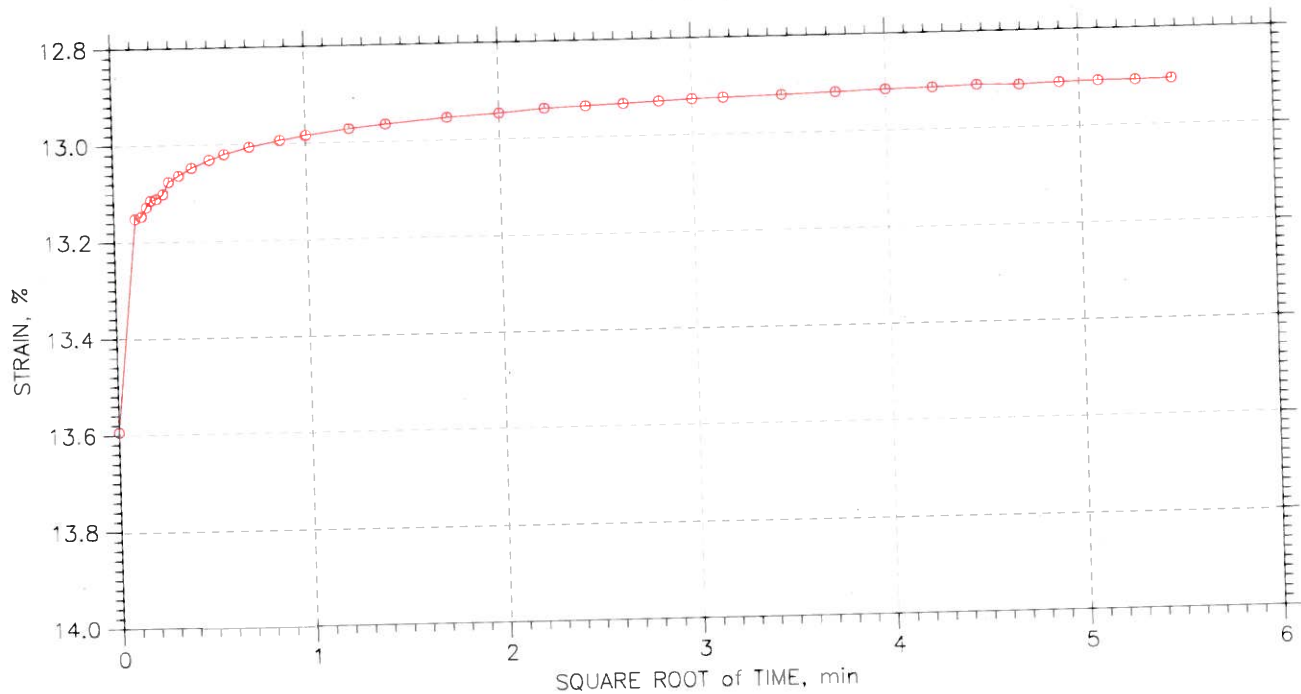
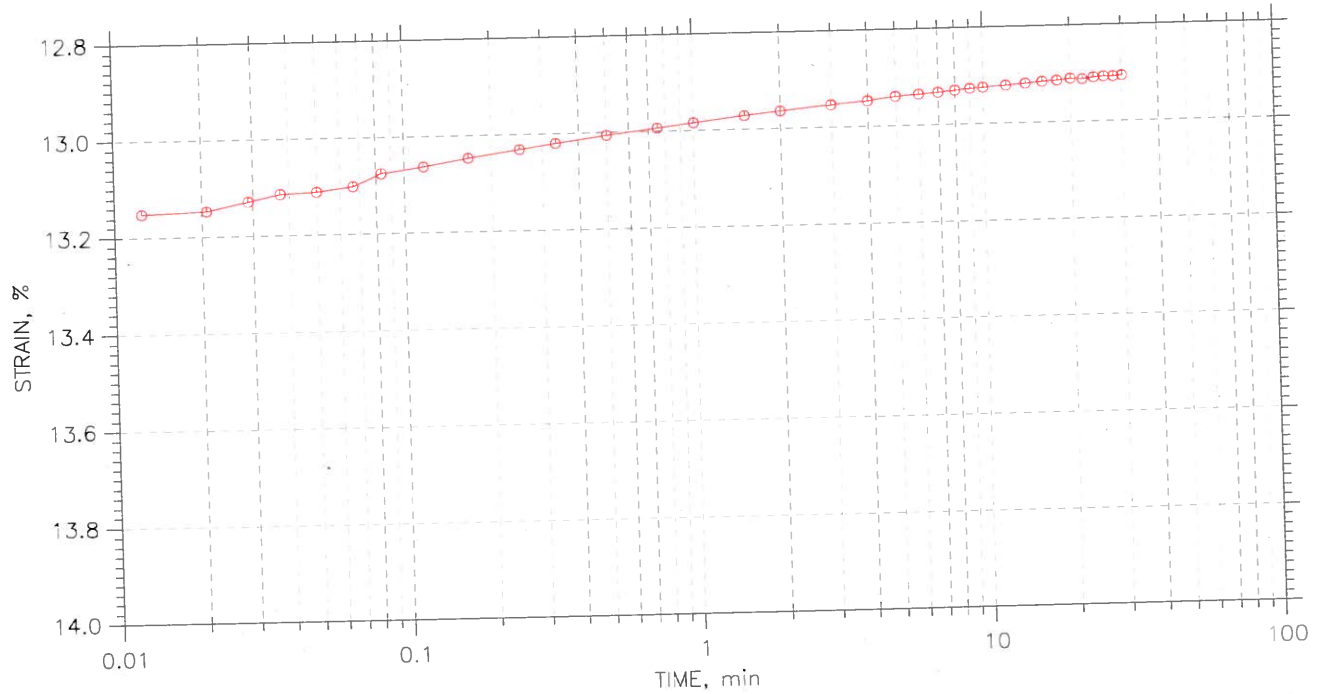
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 8

Stress: 1. tsf



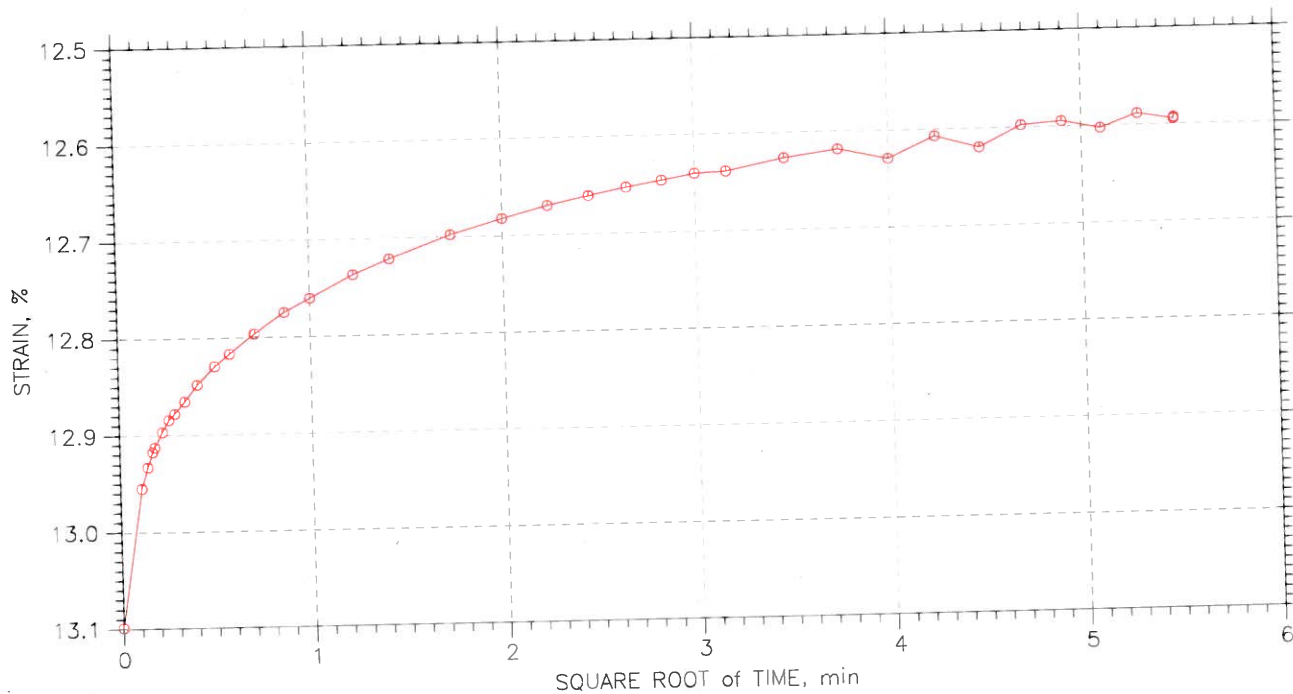
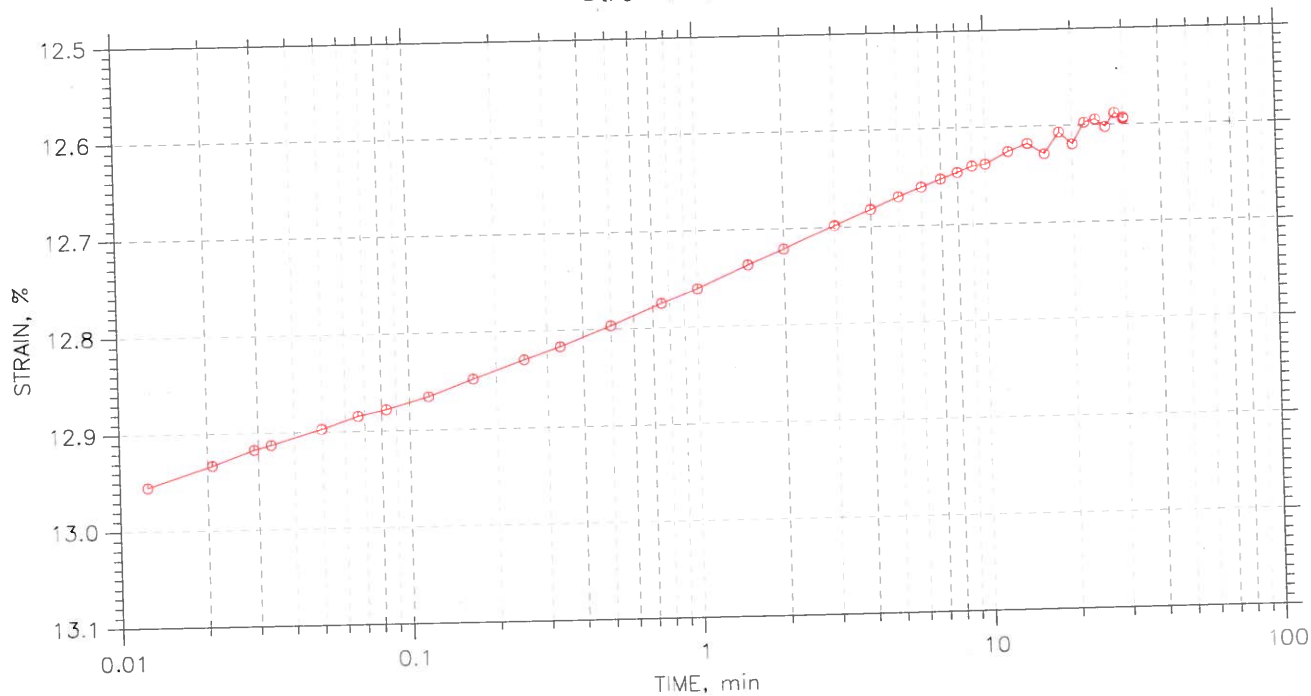
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

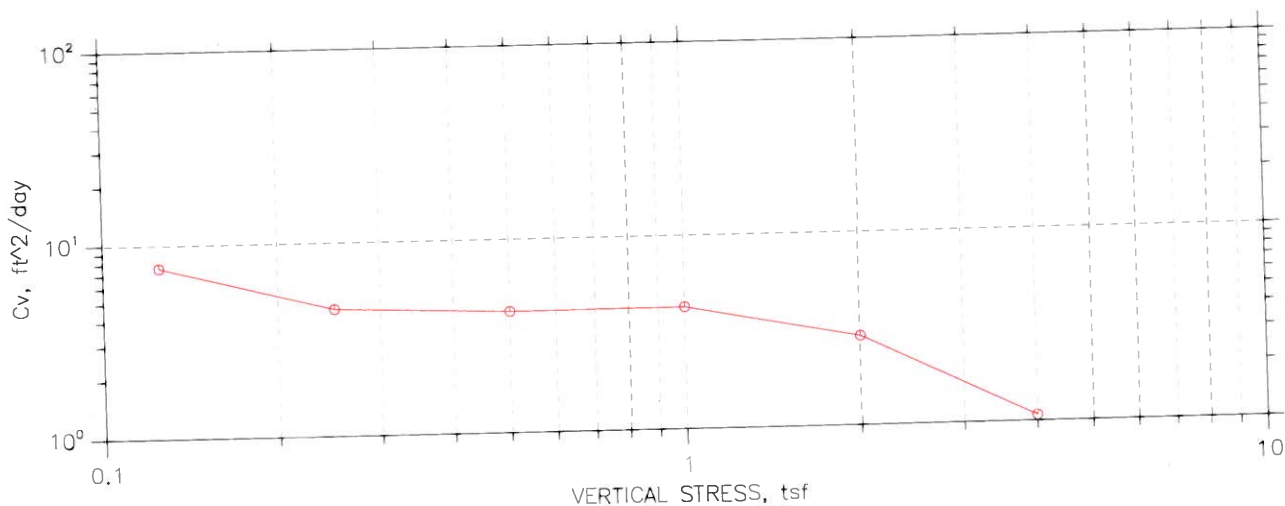
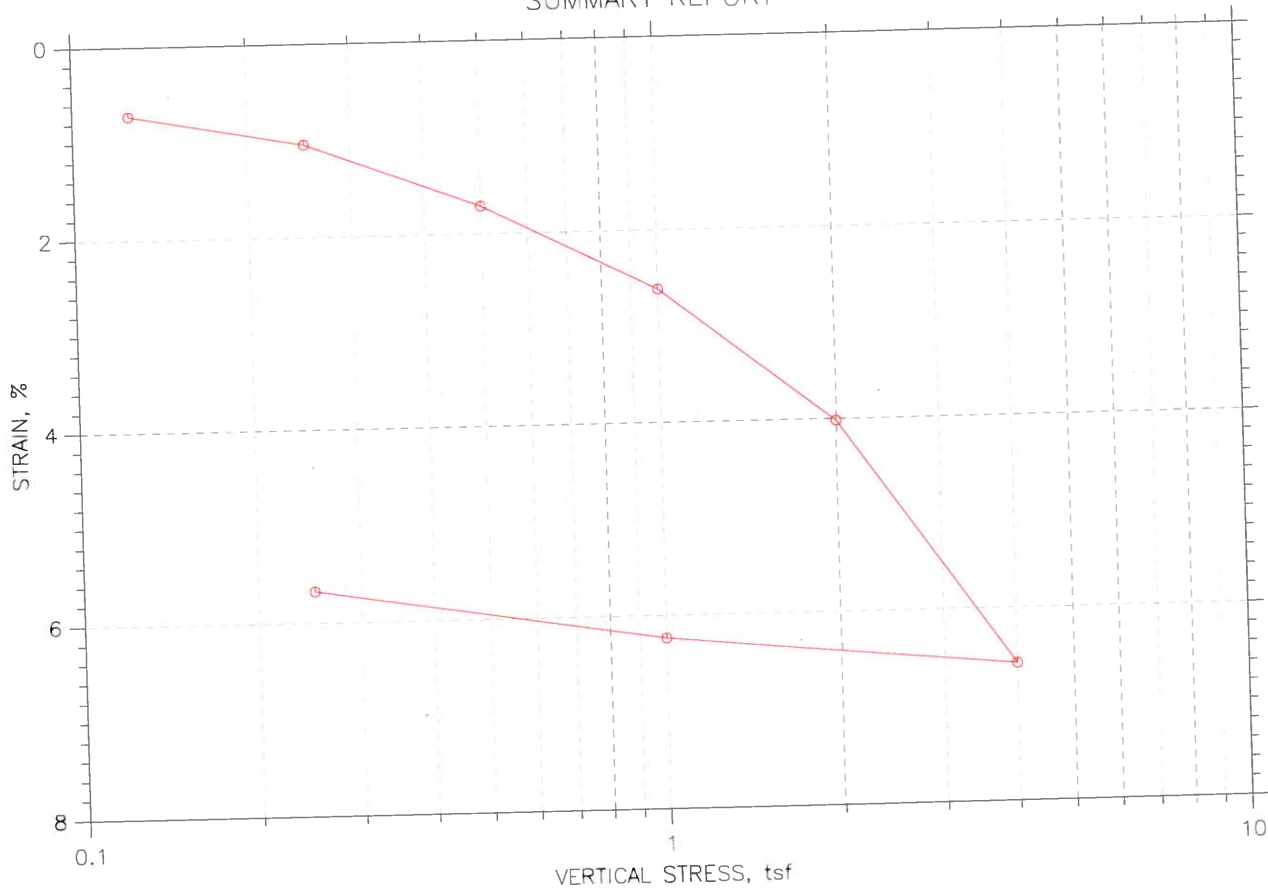
Constant Load Step: 8 of 8

Stress: 0.25 tsf



GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-014	Test Date: 10-24-07	Depth: ---
	Test No.: 21677	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

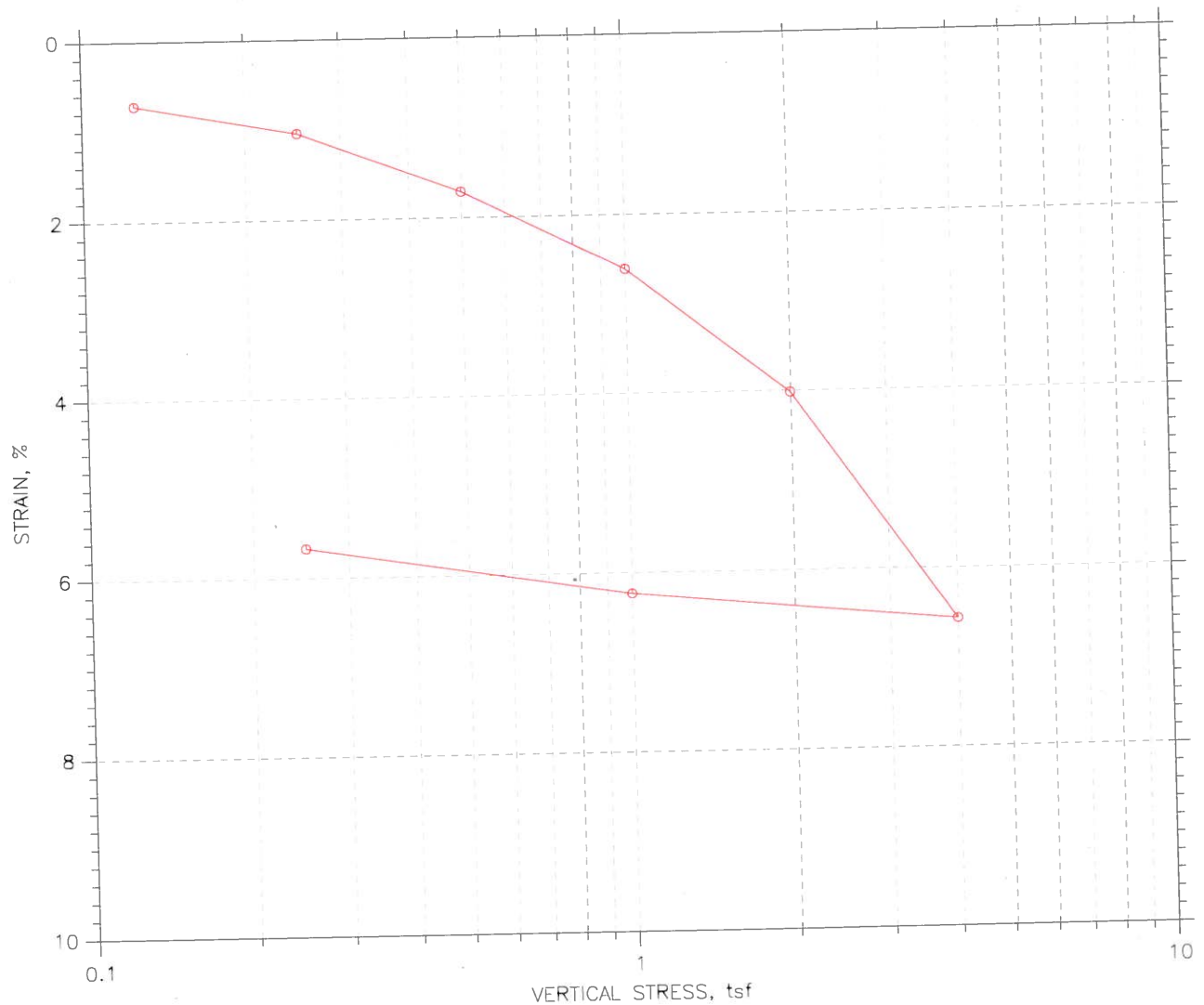
CONSOLIDATION TEST DATA SUMMARY REPORT



GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 tsf				133.02	127.96
Preconsolidation Pressure: 0 tsf				33.35	35.35
Compression Index: 0				89.43	92.64
Diameter: 2.5 in		Height: 1.003 in		3.87	3.59
LL: NP	PL: NP	PI: NP	GS: 2.60		

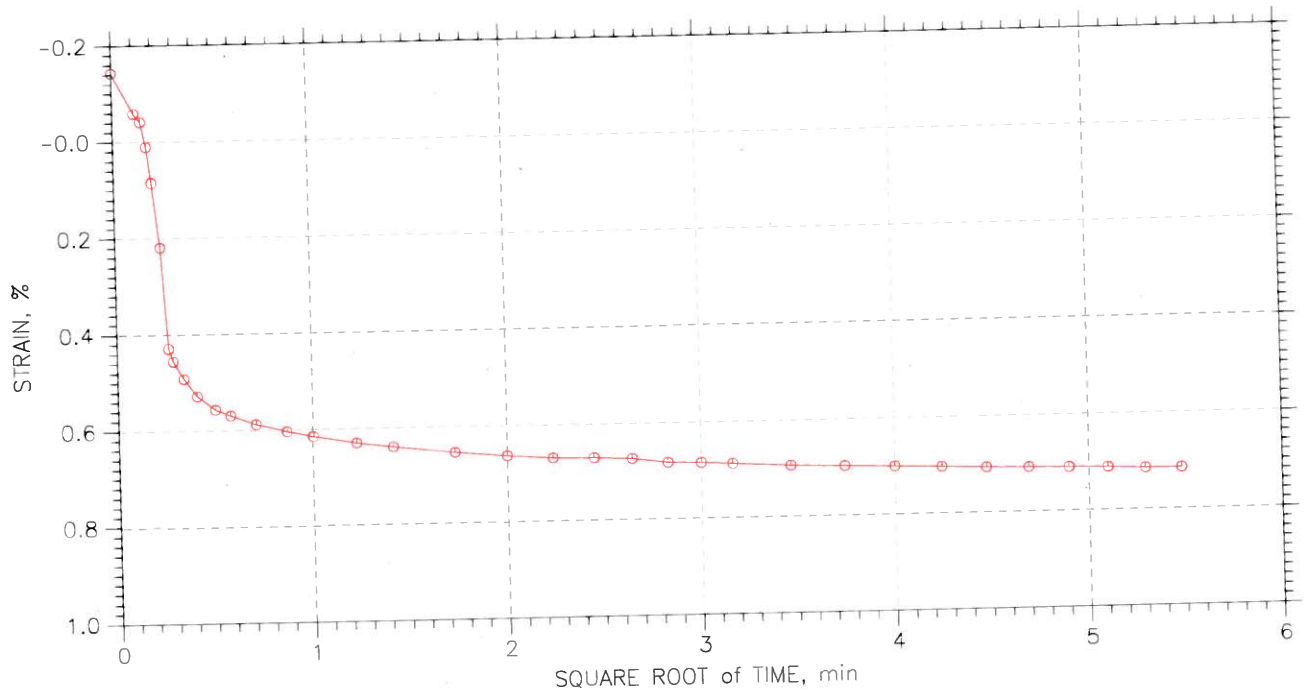
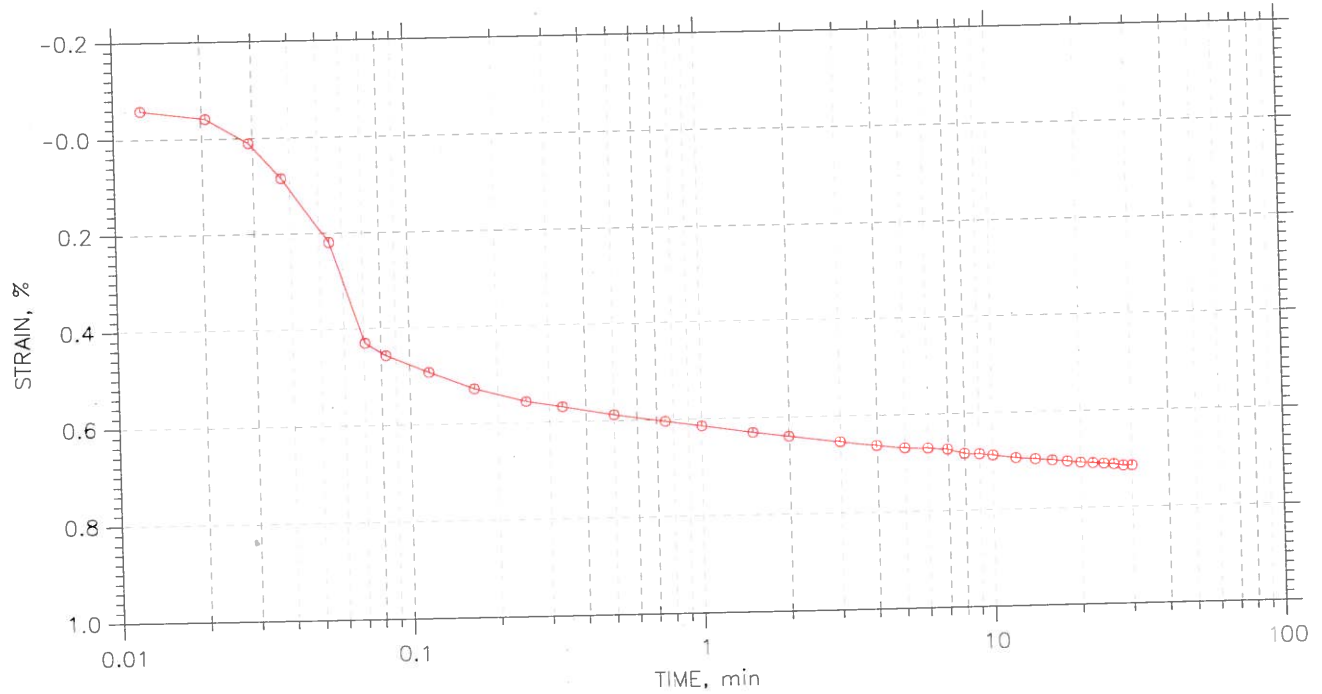
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 8

Stress: 0.125 tsf



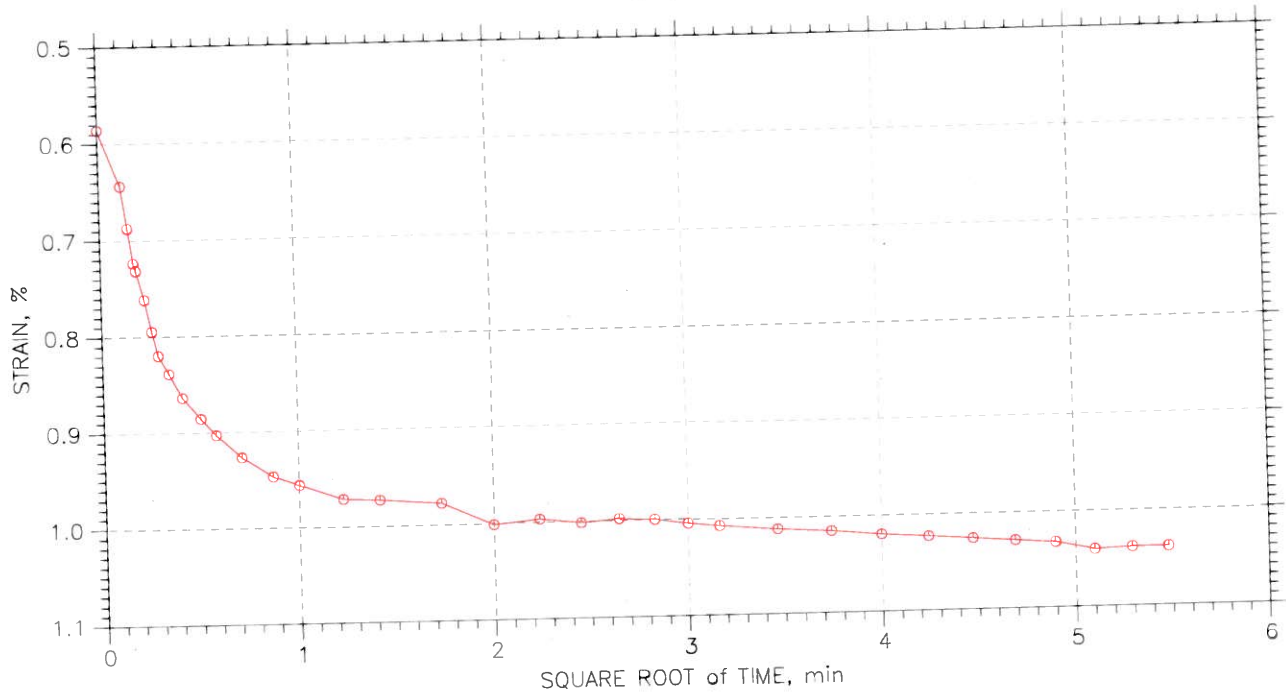
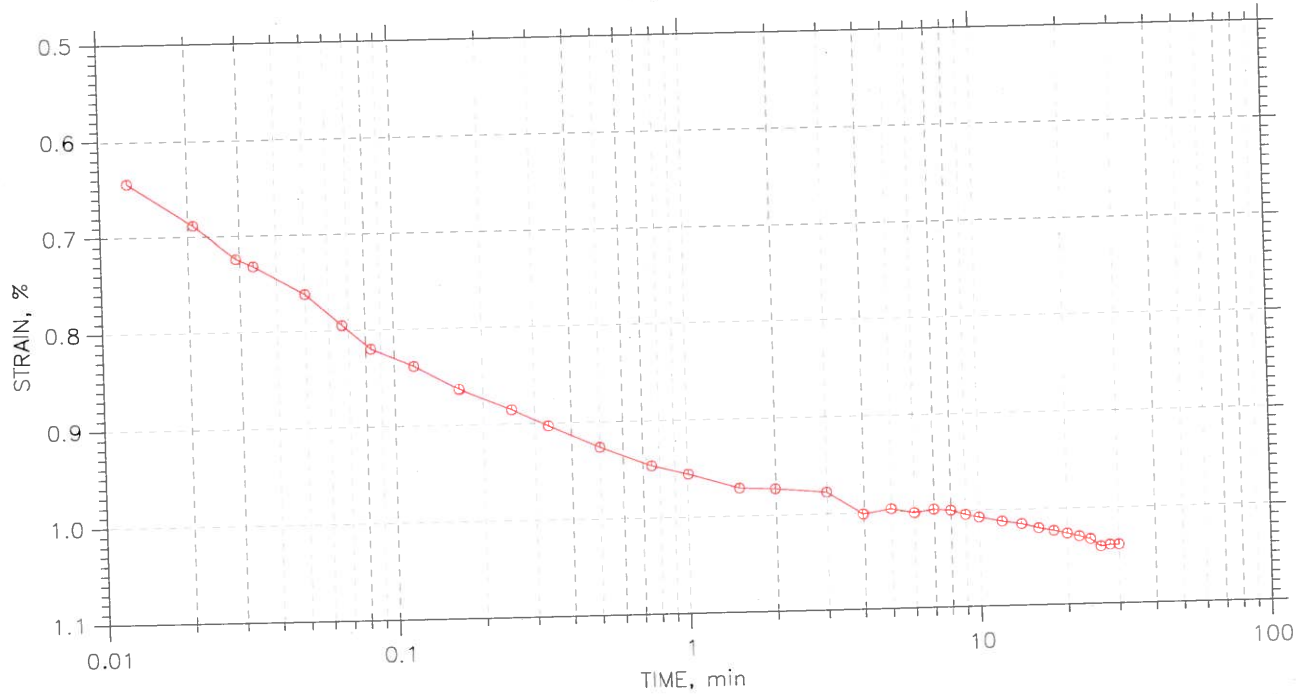
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 8

Stress: 0.25 tsf



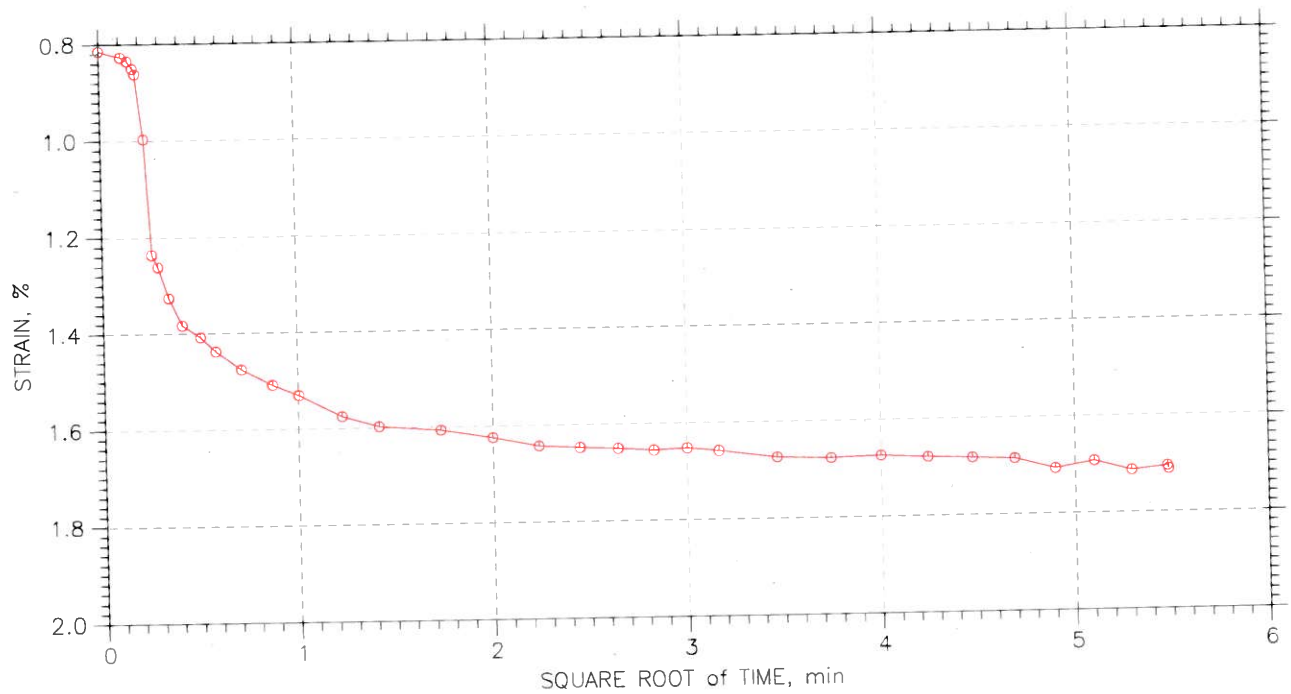
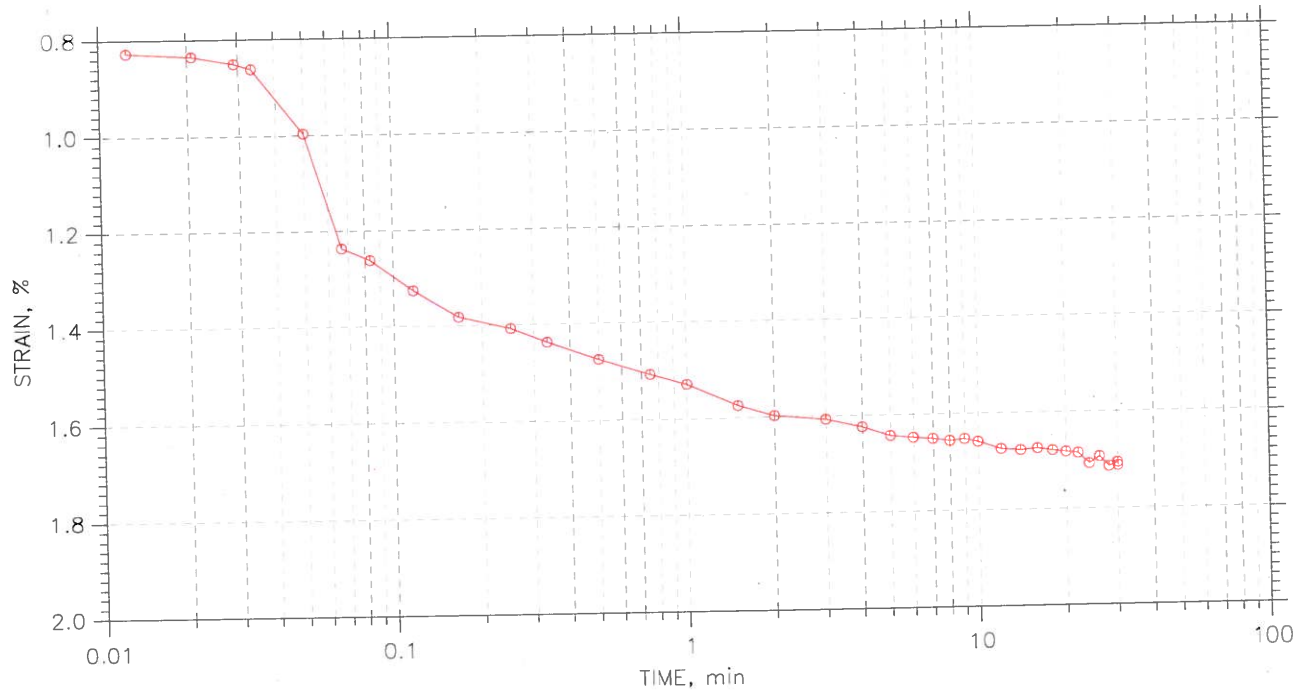
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 8

Stress: 0.5 tsf



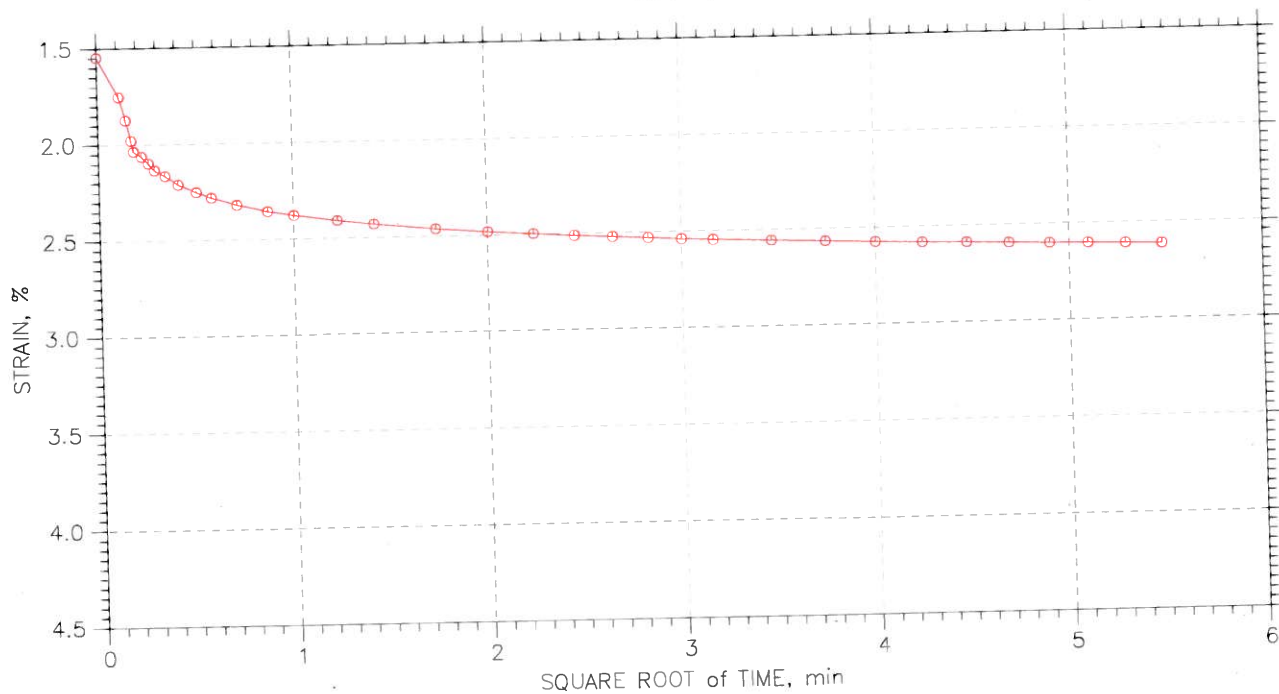
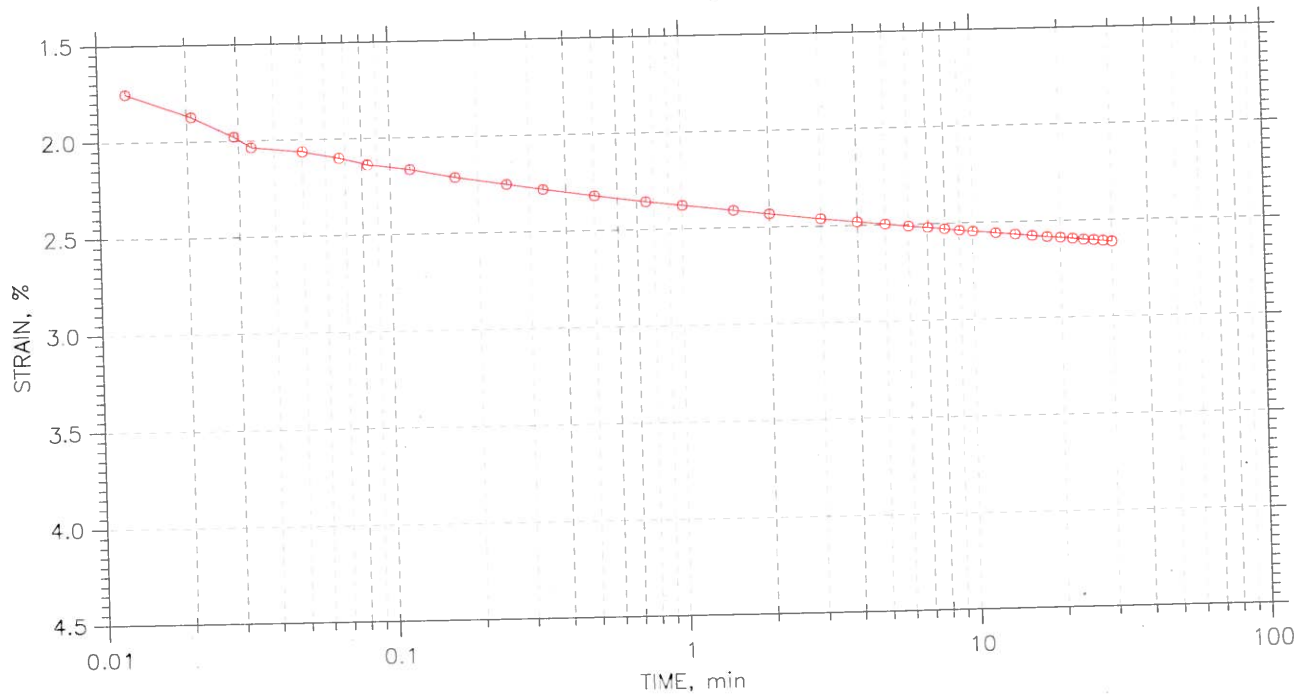
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 8

Stress: 1. tsf



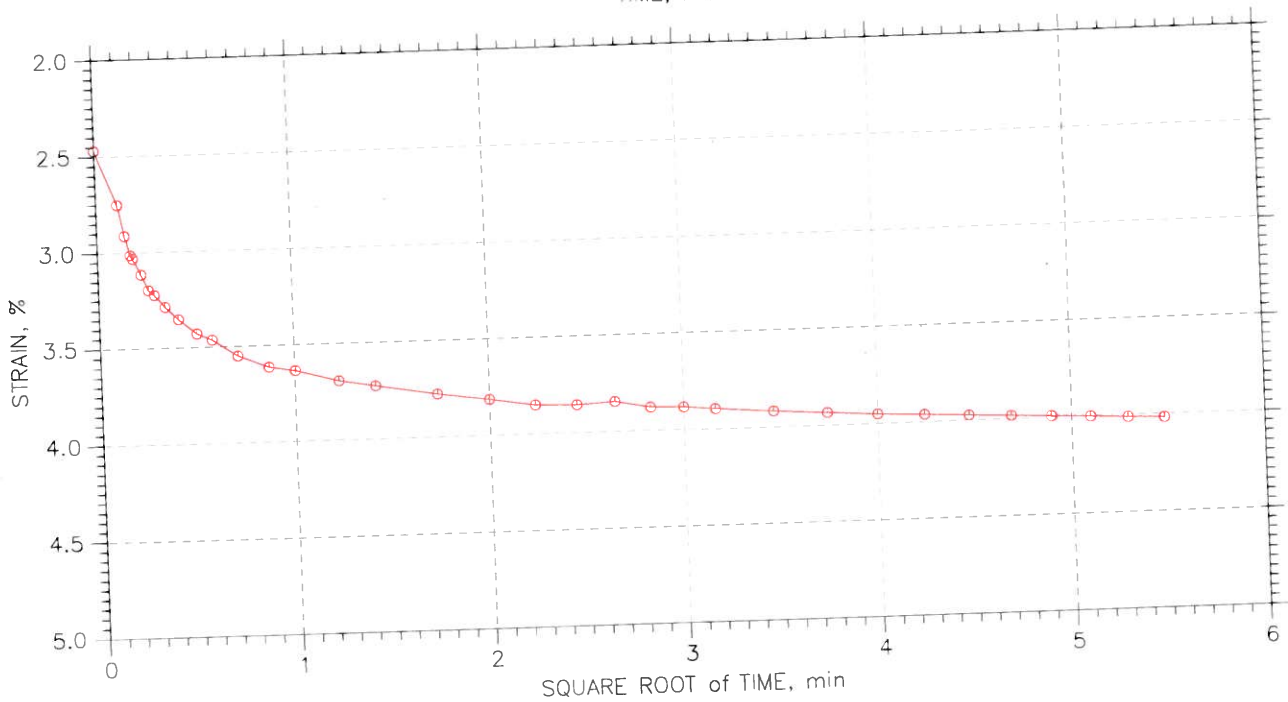
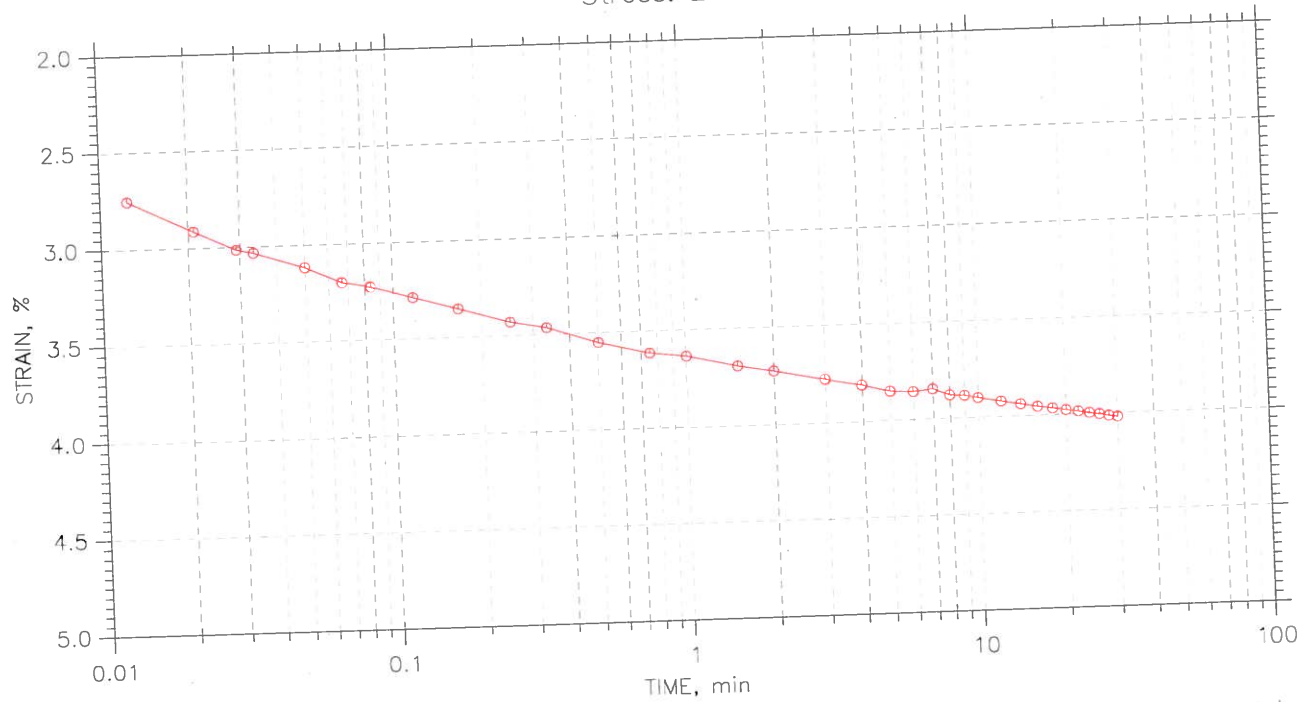
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 8

Stress: 2. tsf



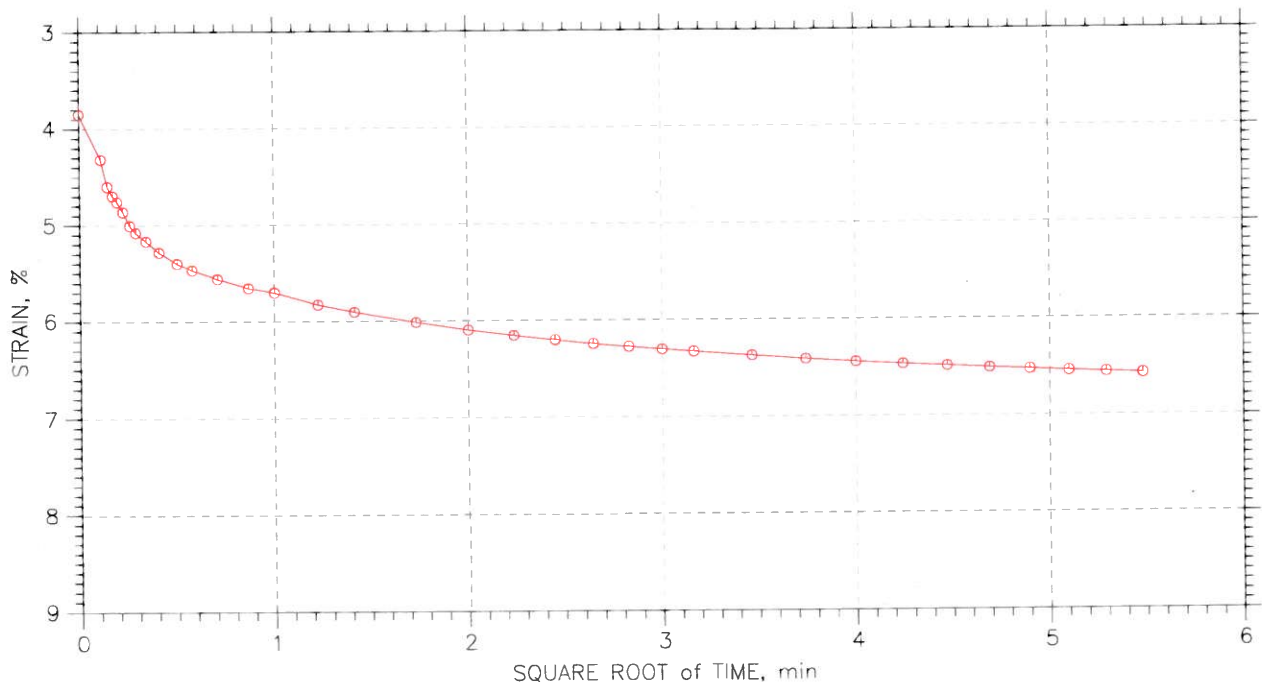
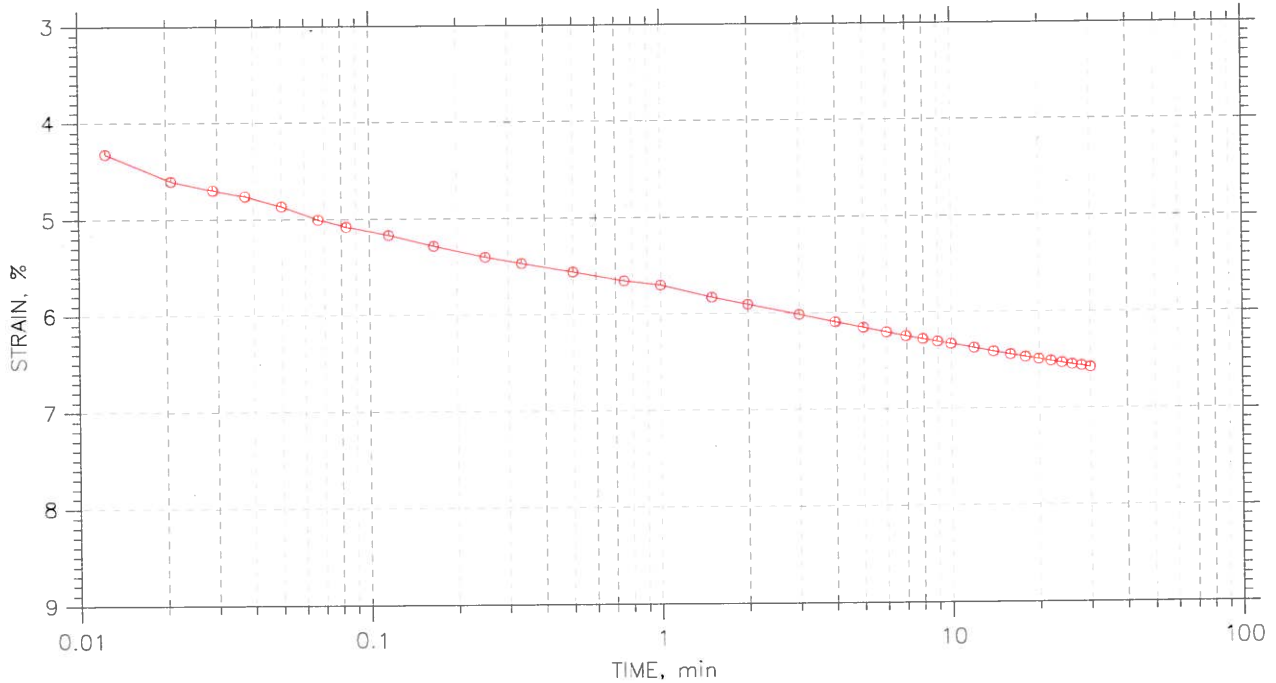
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 8

Stress: 4. tsf



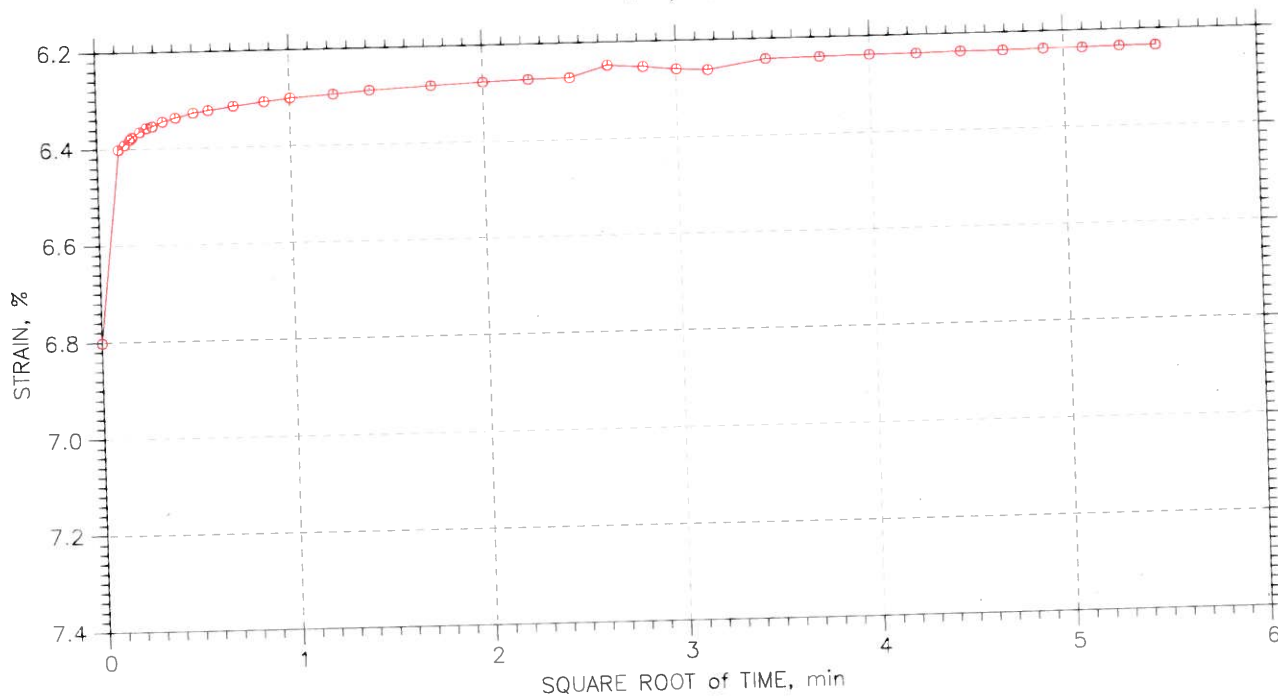
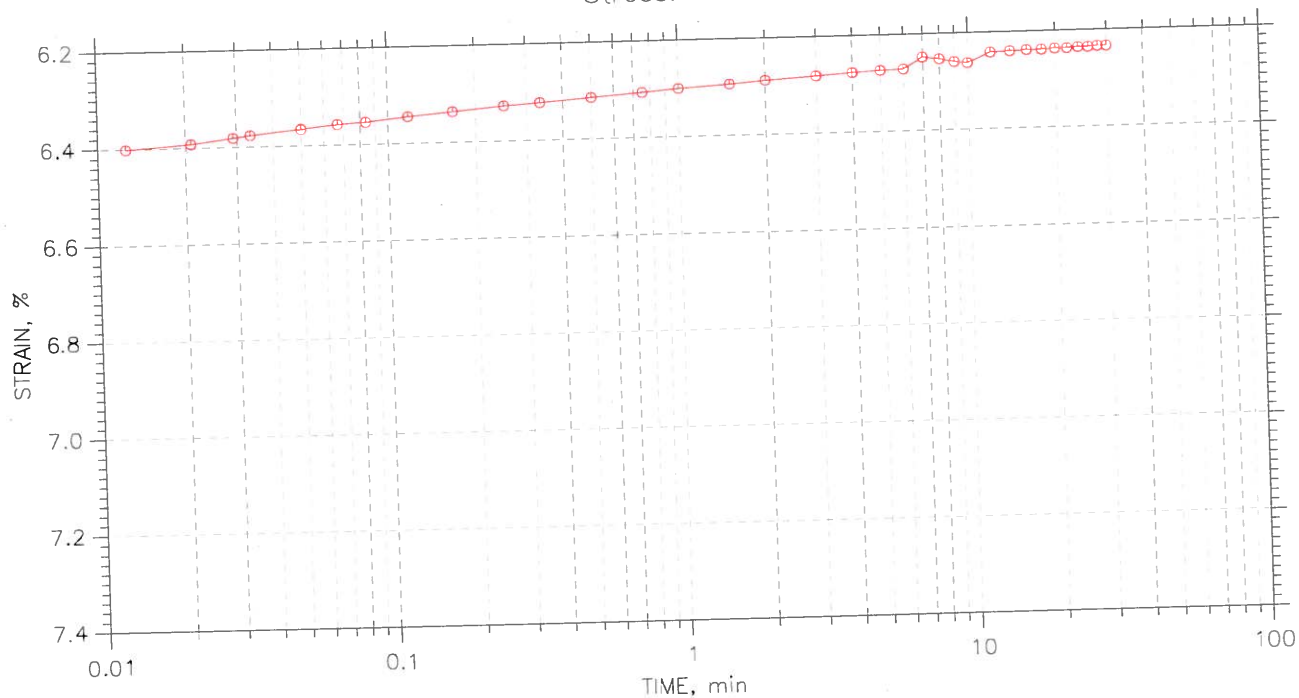
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 8

Stress: 1. tsf



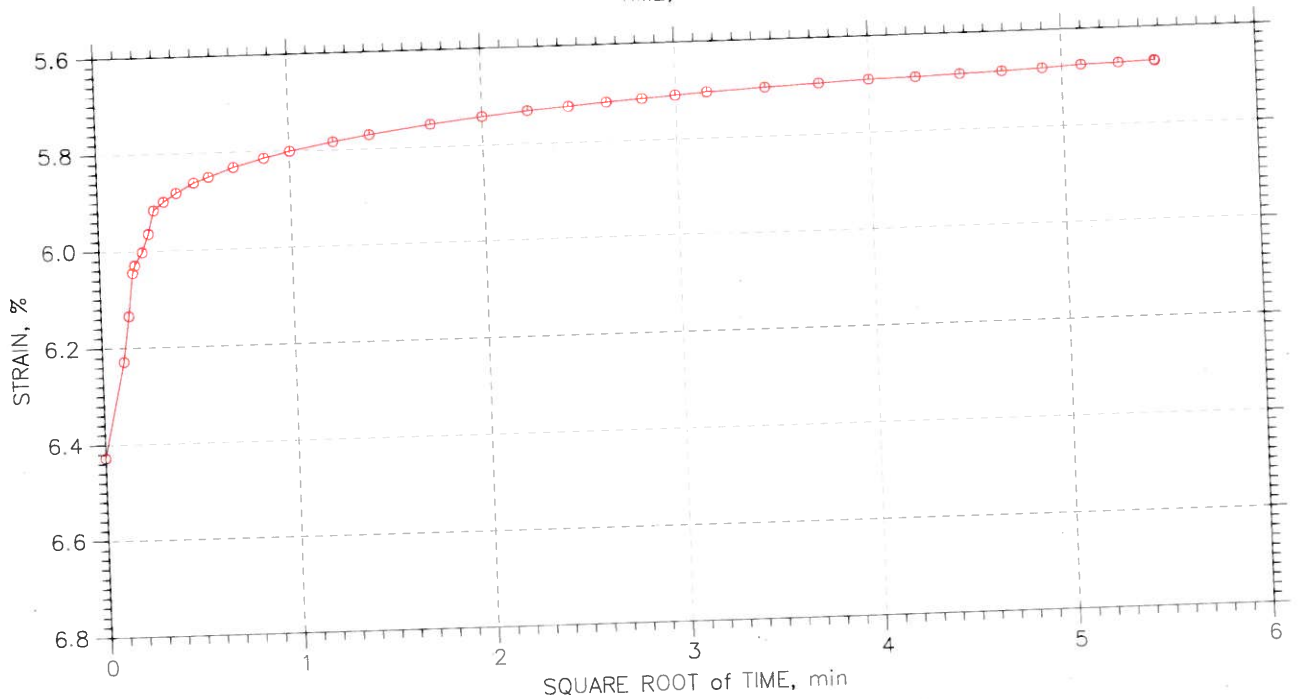
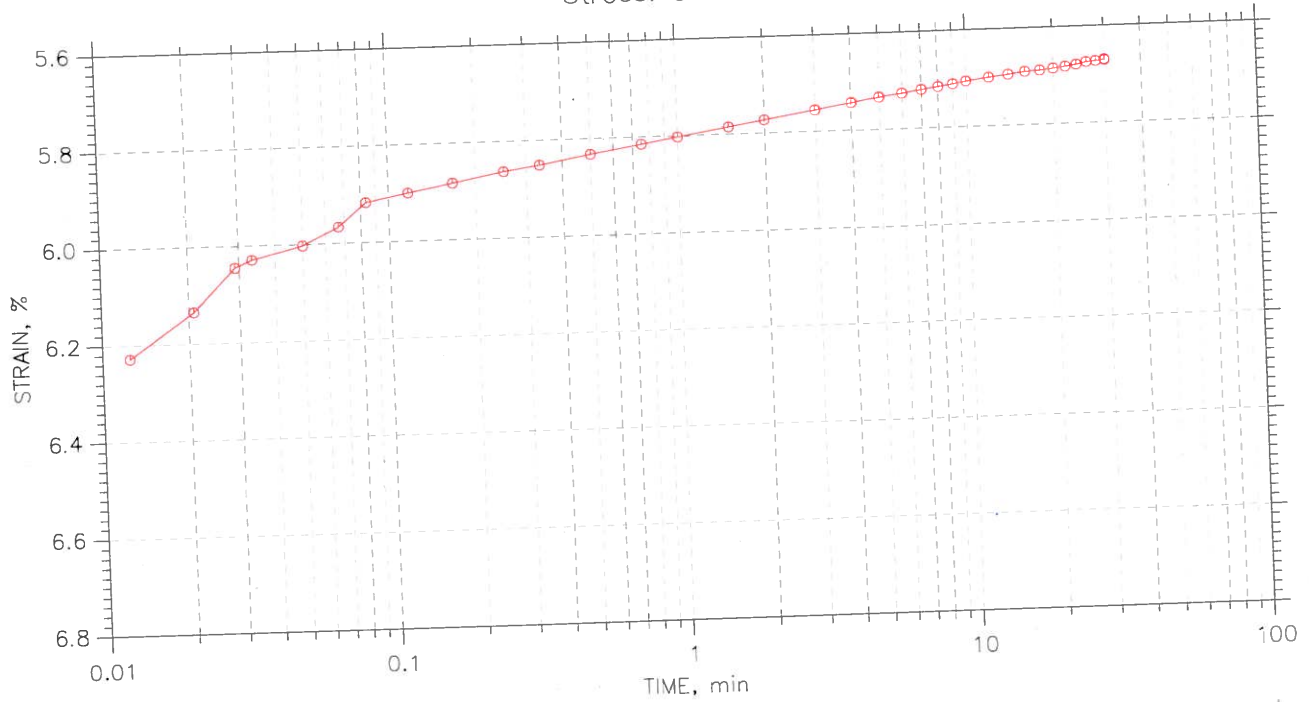
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

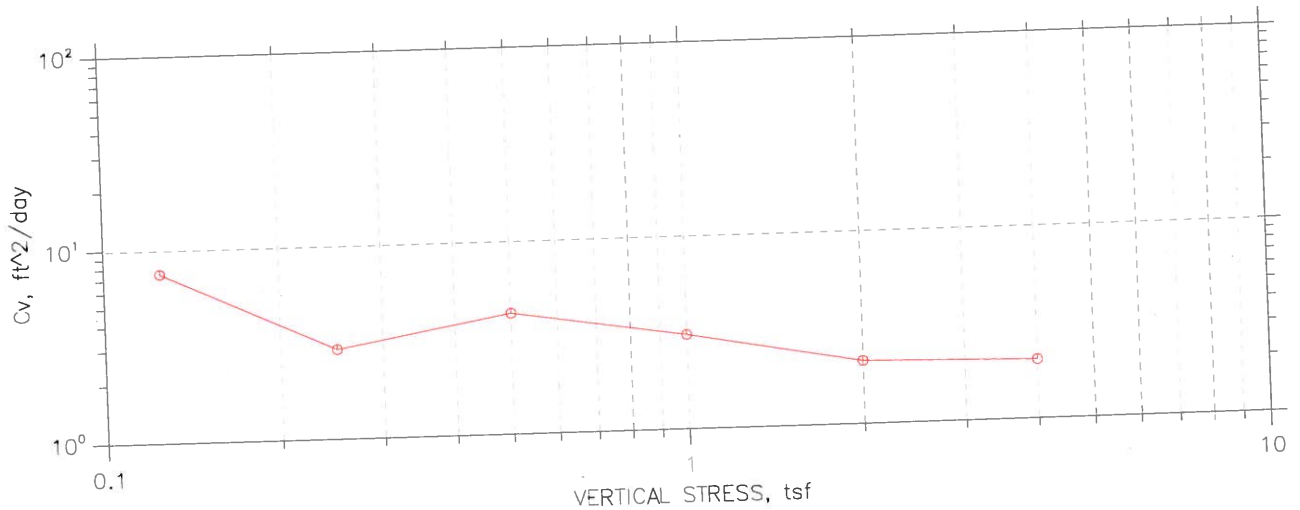
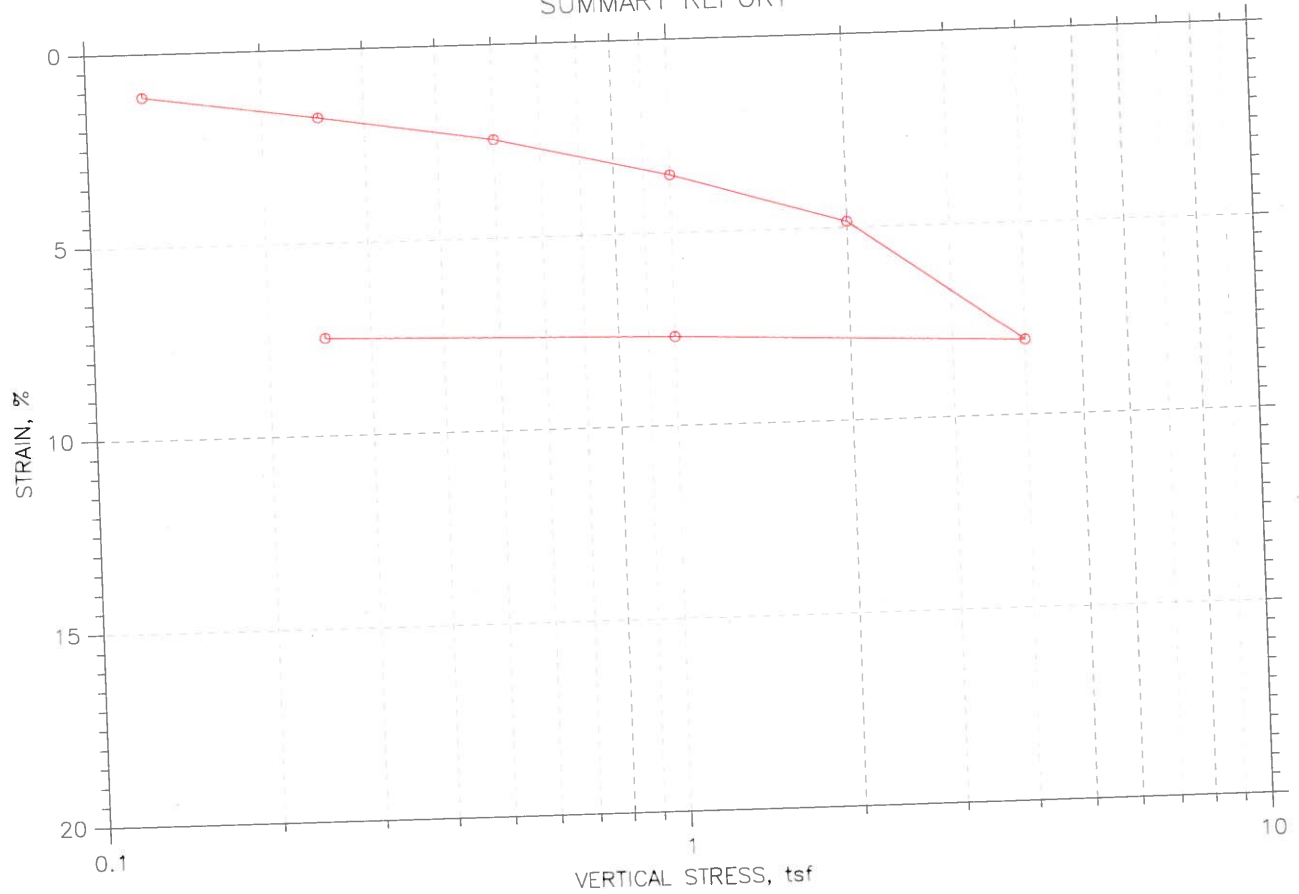
Constant Load Step: 8 of 8

Stress: 0.25 tsf



GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-022	Test Date: 10-30-07	Depth: ---
	Test No.: 21678	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

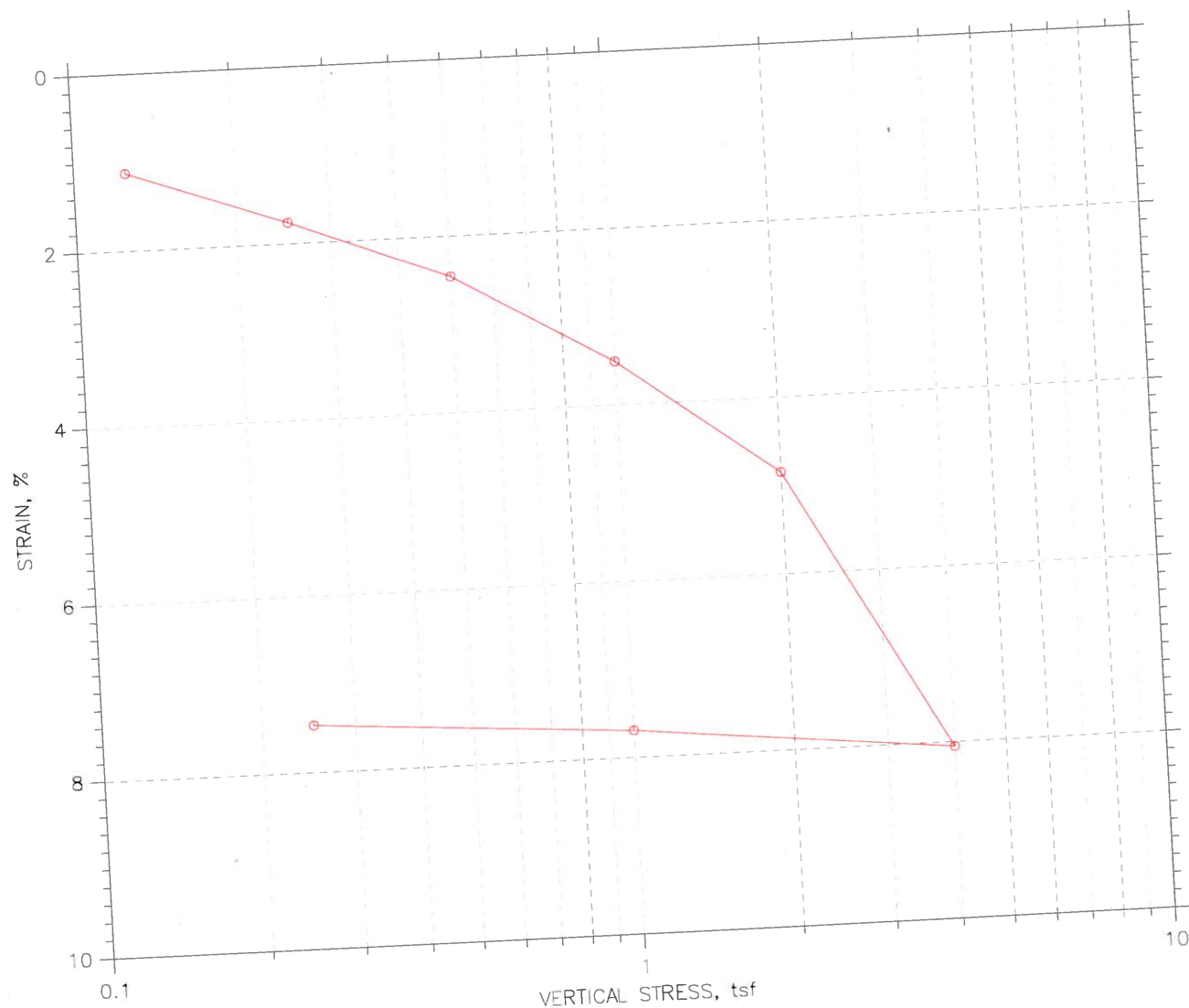
CONSOLIDATION TEST DATA SUMMARY REPORT



GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 tsf				120.85	115.53
Preconsolidation Pressure: 0 tsf				35.78	38.66
Compression Index: 0				88.84	93.92
Diameter: 2.5 in				3.54	3.20
Height: 1.01 in					
LL: NP					
PL: NP					
PI: NP					
GS: 2.60					

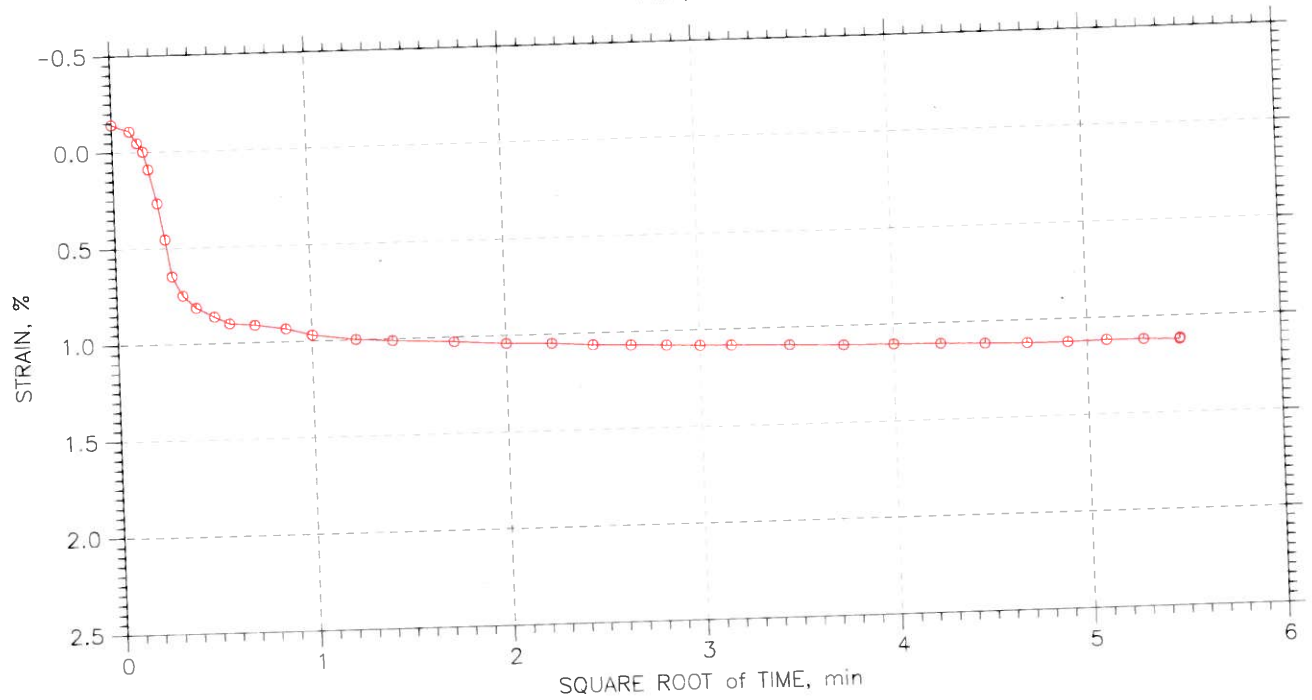
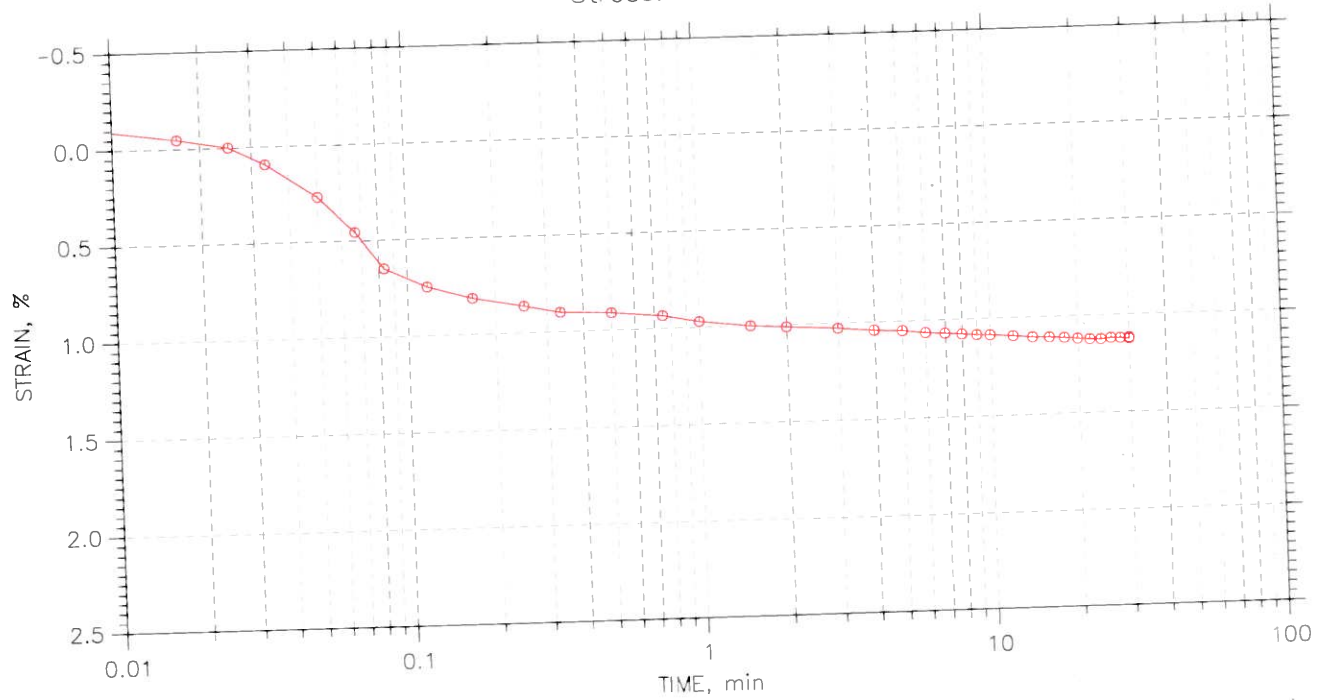
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 8

Stress: 0.125 tsf



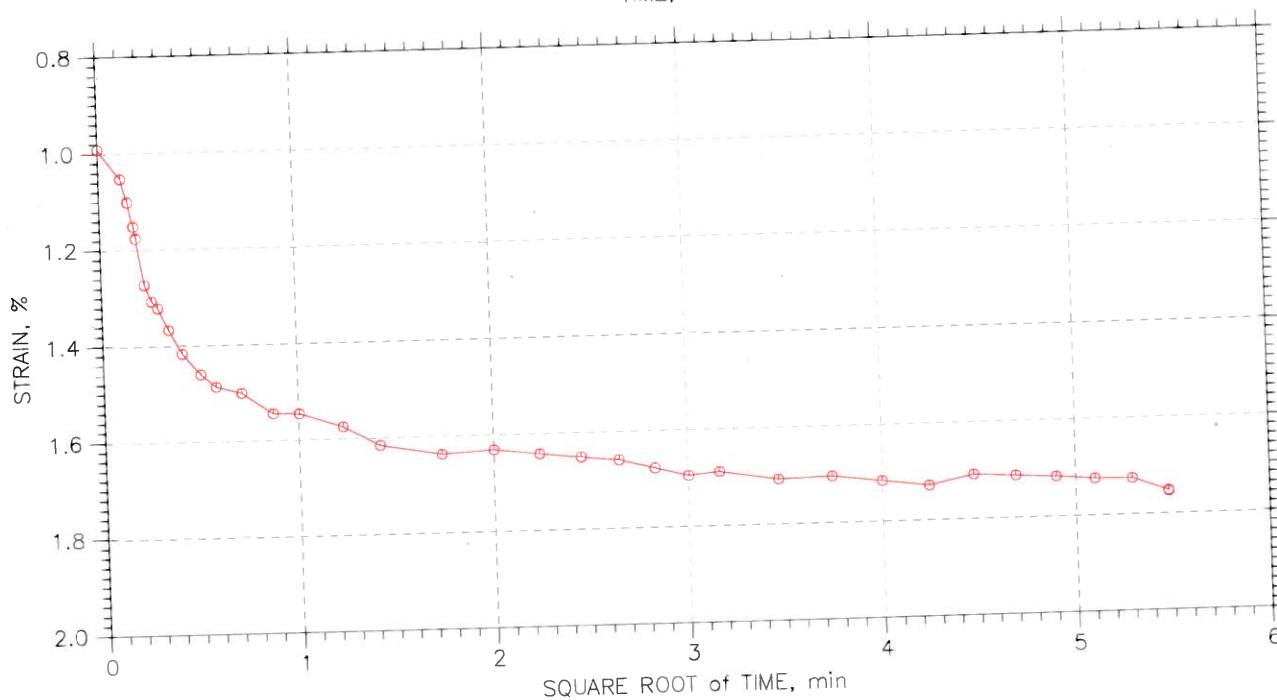
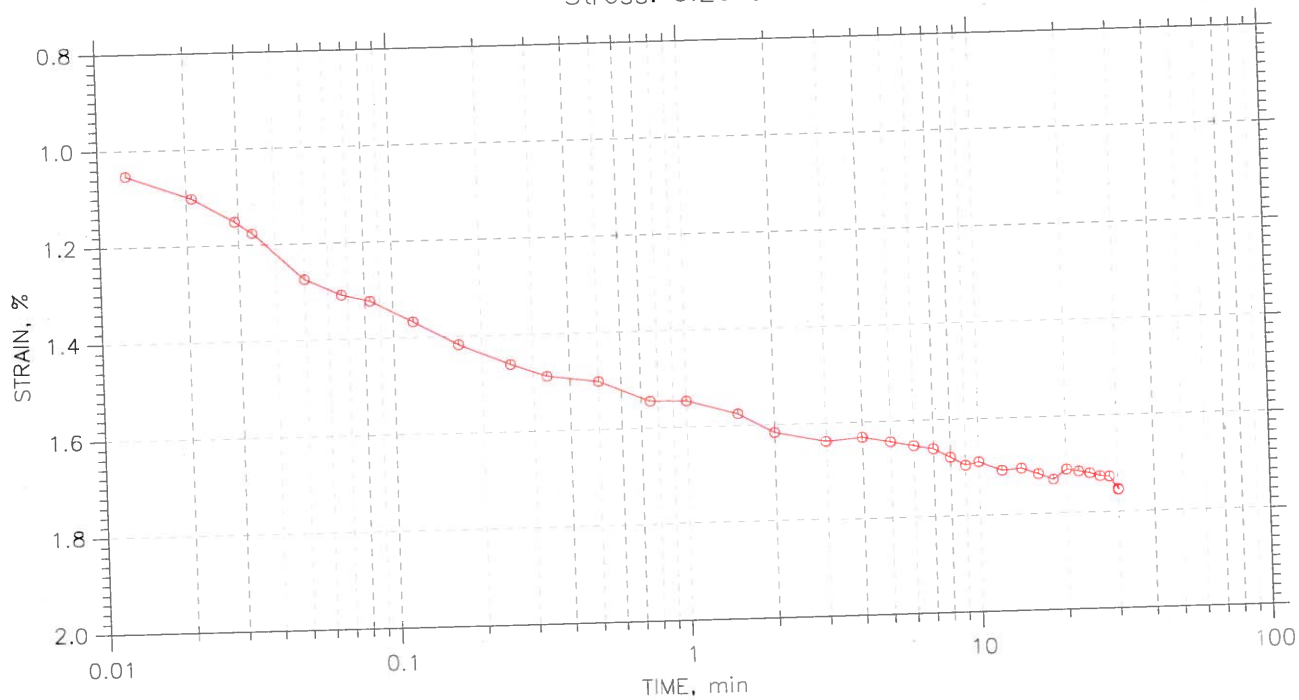
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 8

Stress: 0.25 tsf



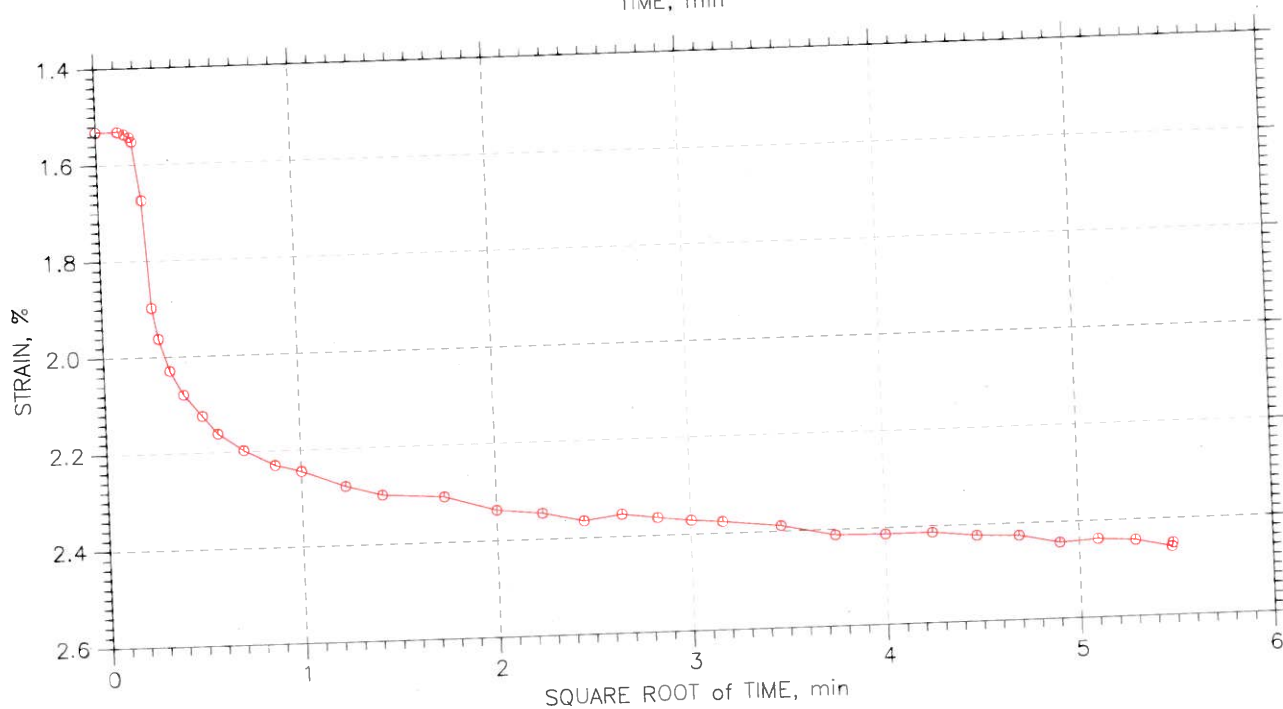
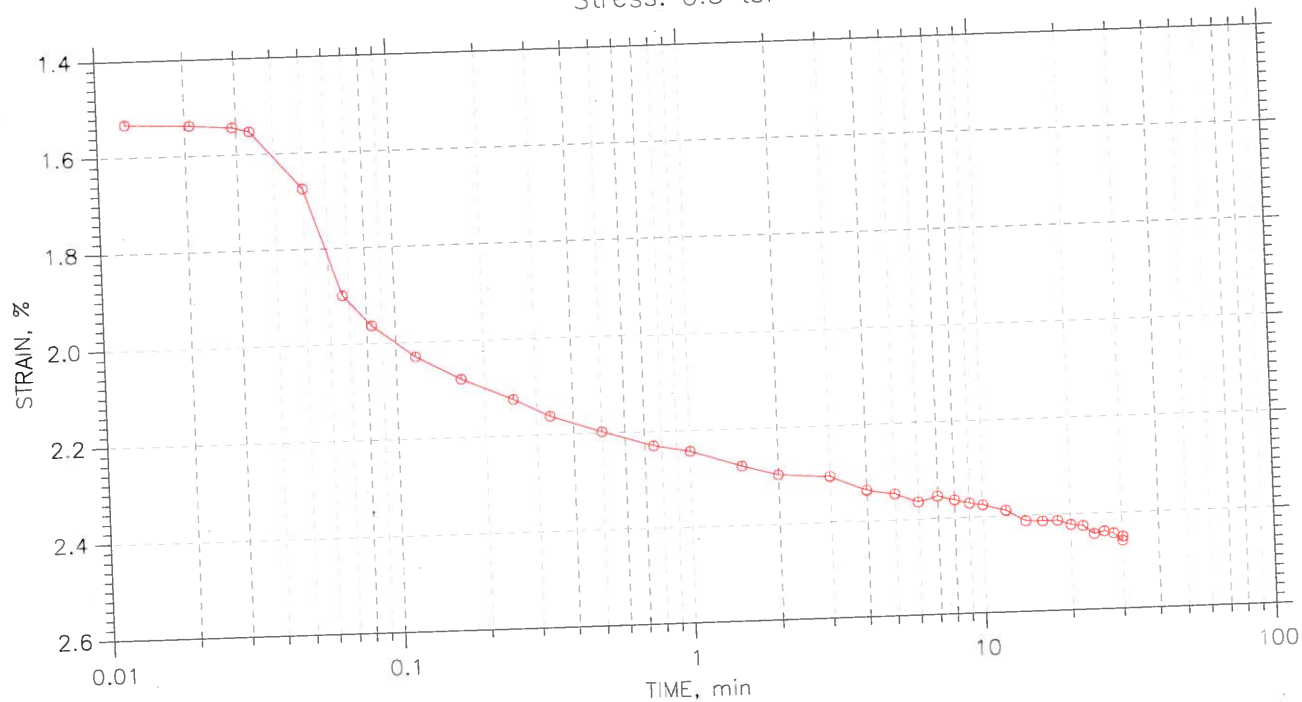
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 8

Stress: 0.5 tsf



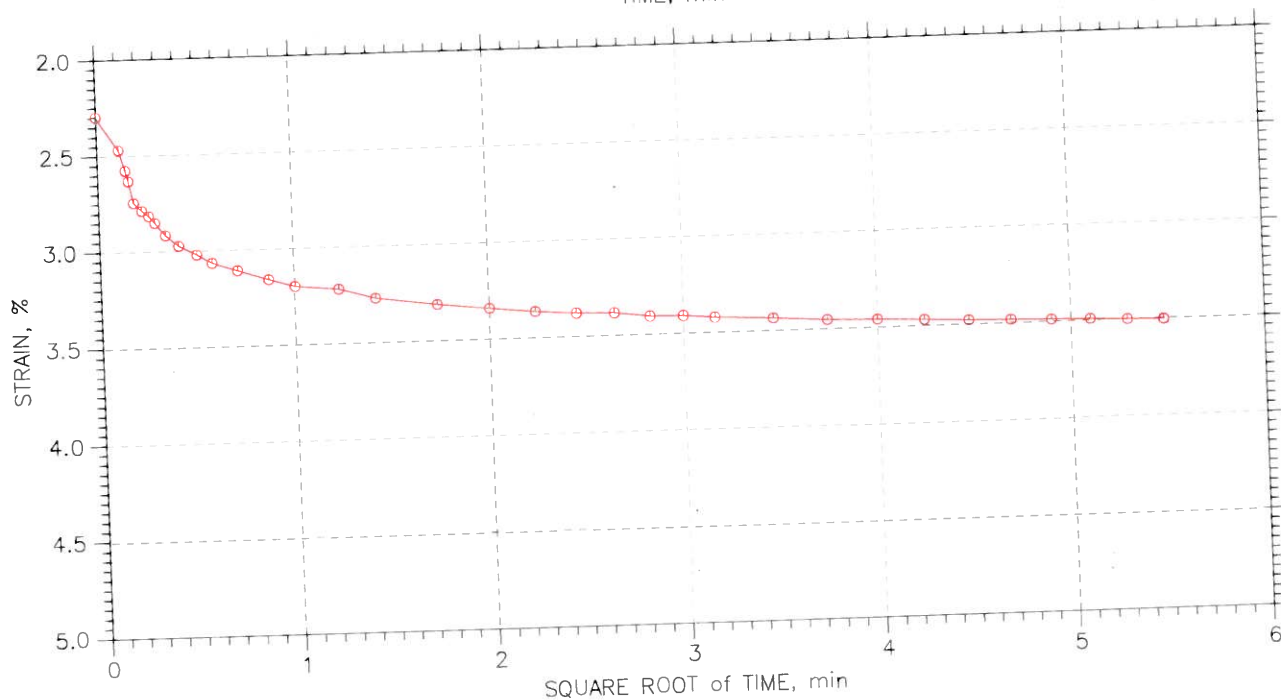
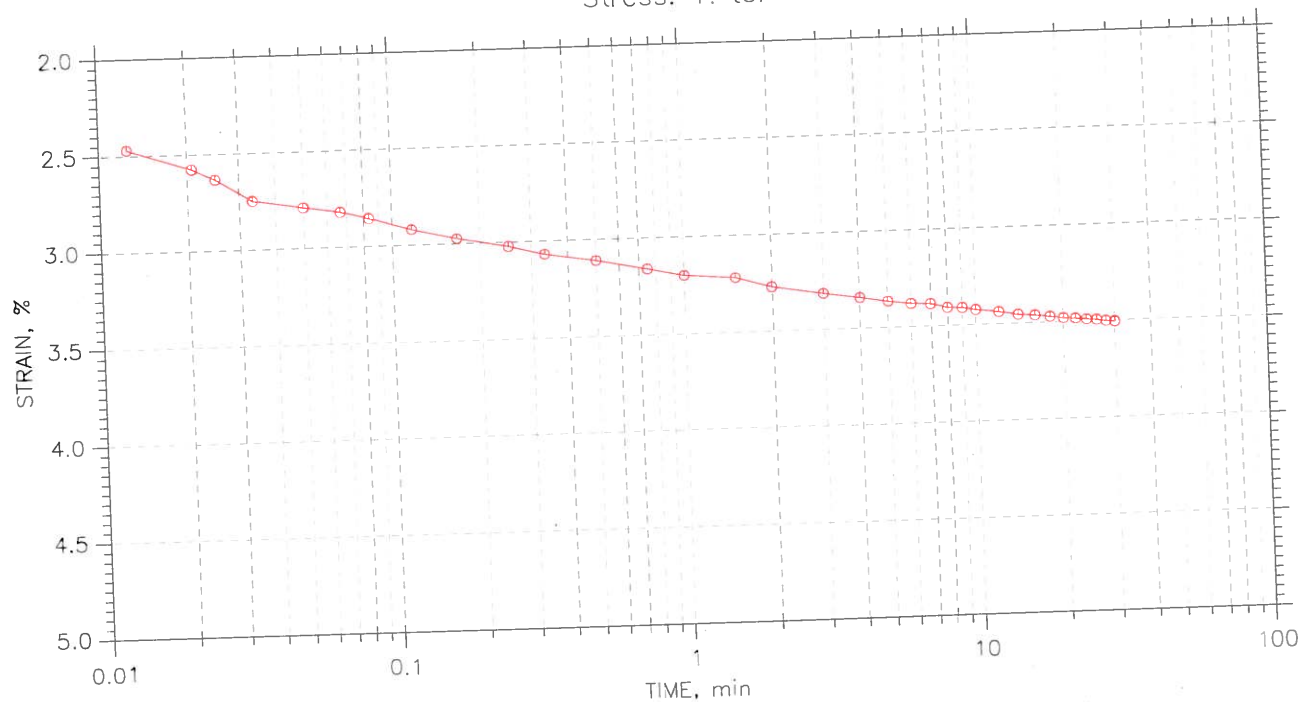
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 8

Stress: 1. tsf



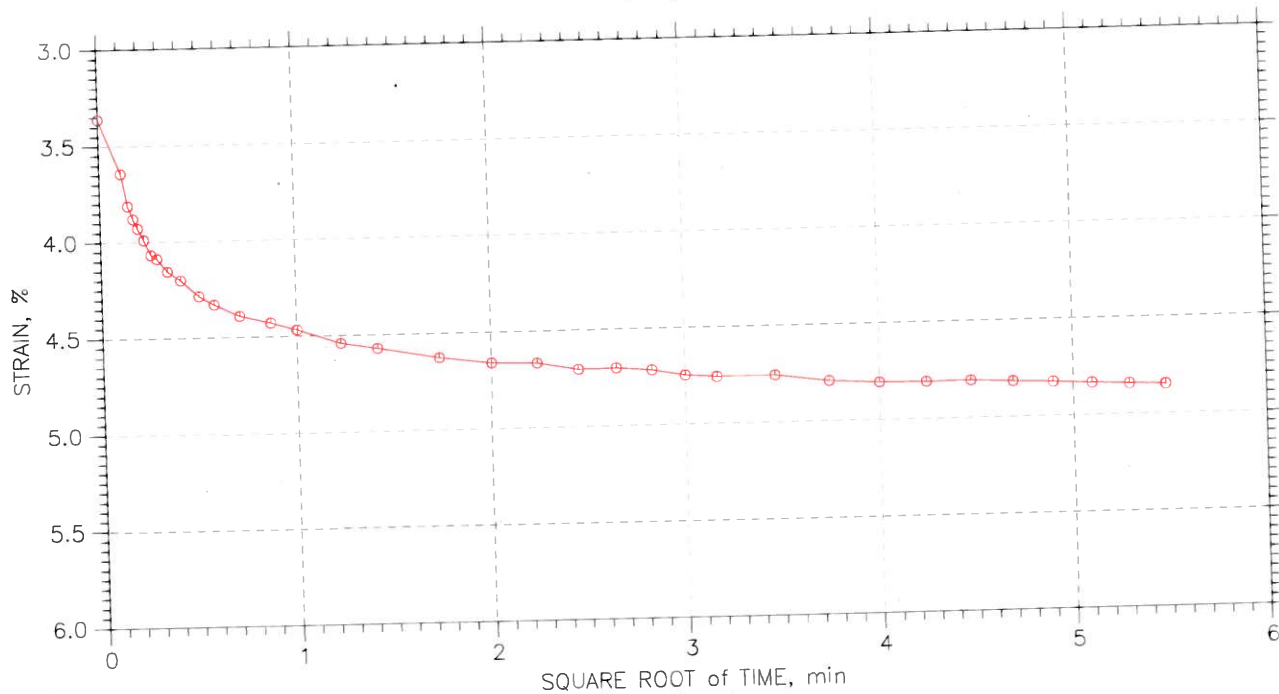
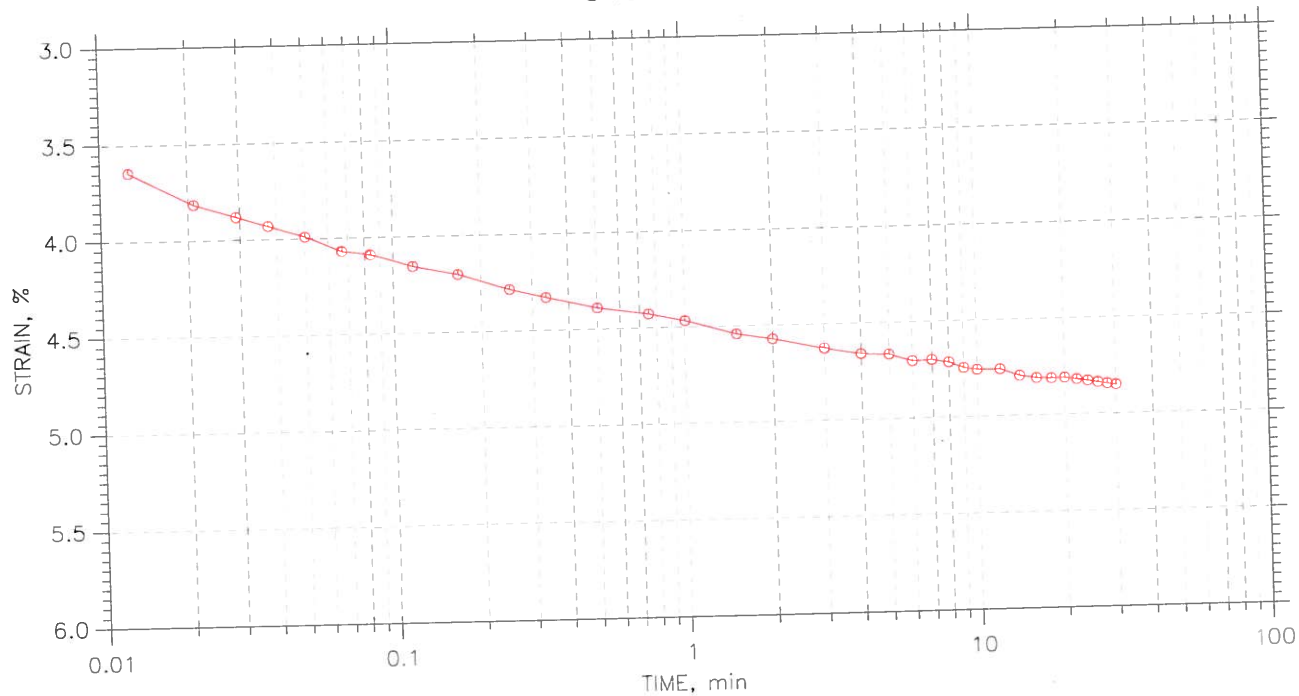
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 8

Stress: 2. tsf



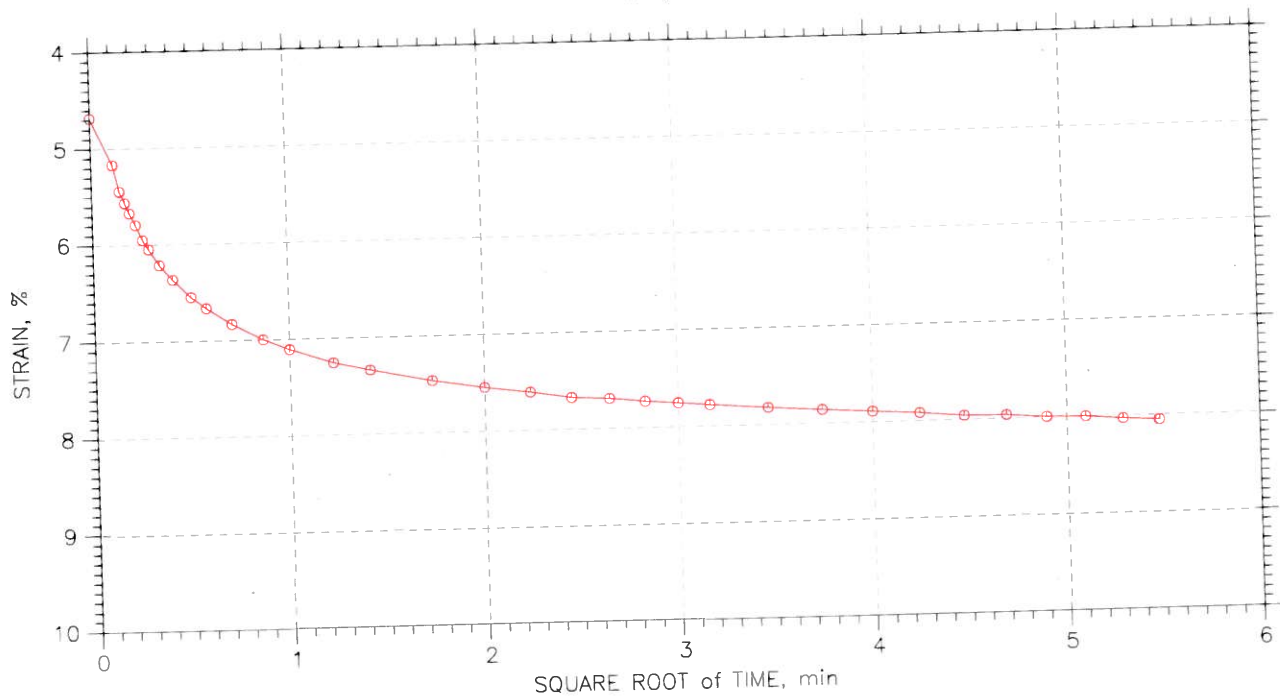
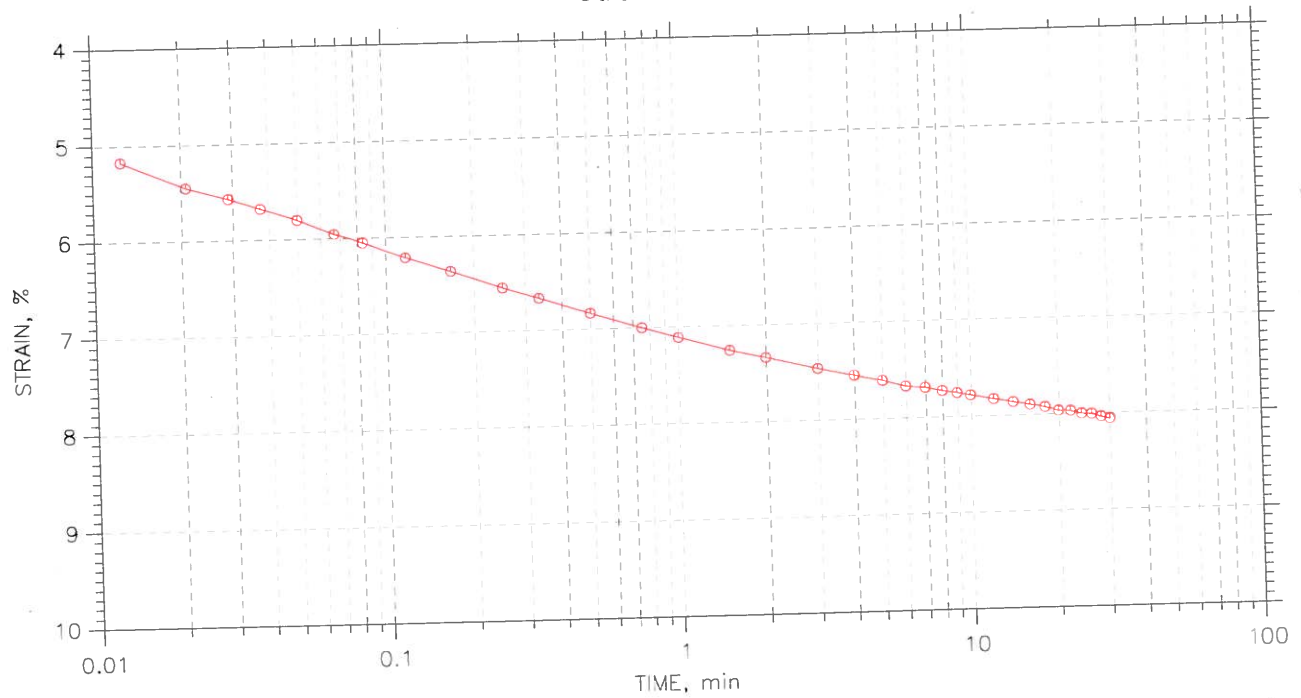
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 8

Stress: 4. tsf



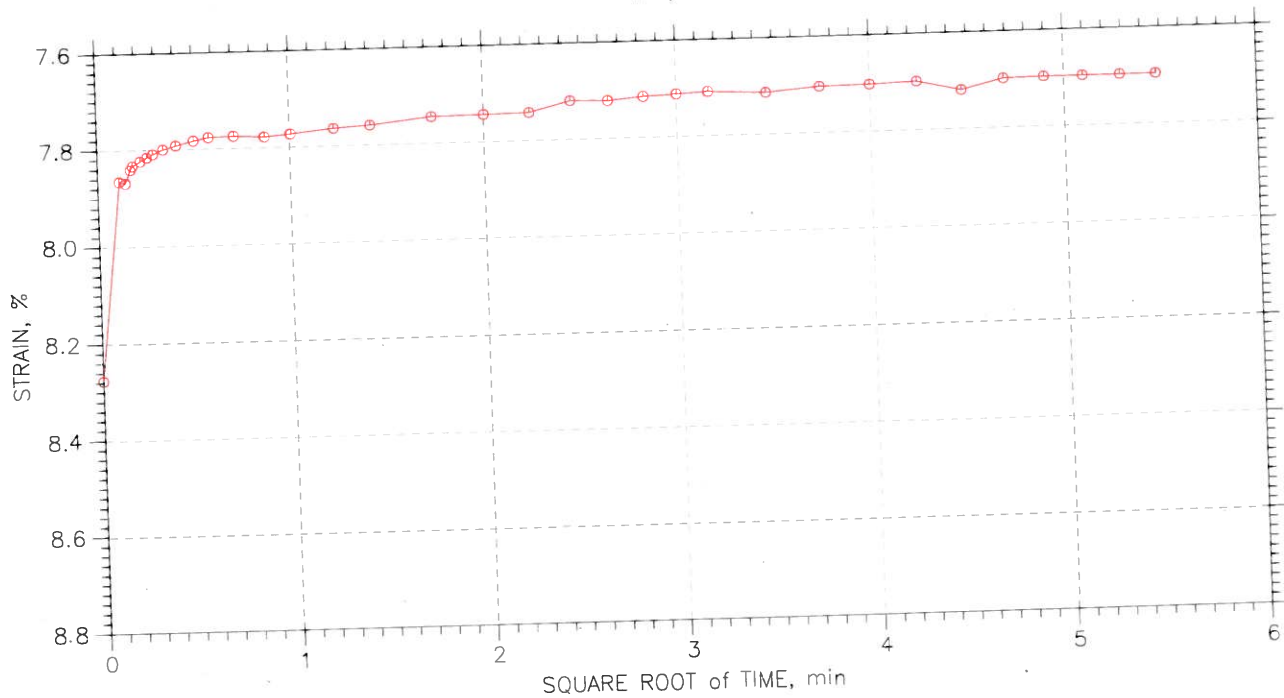
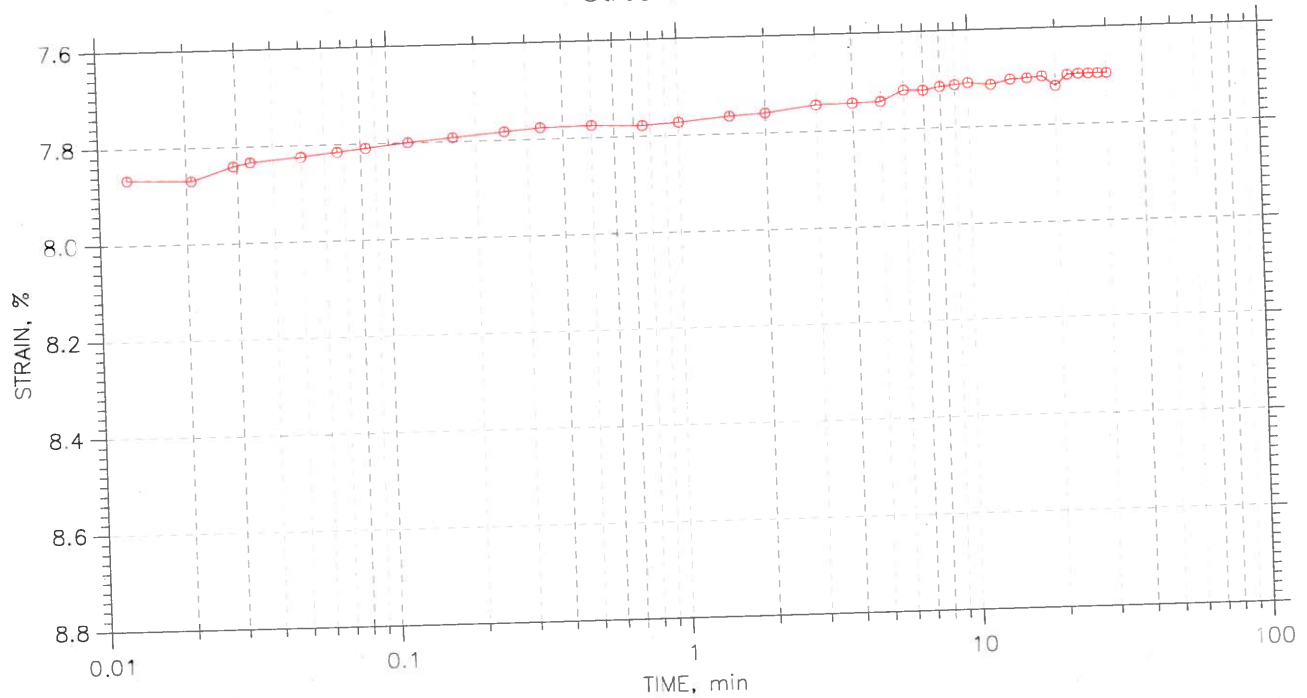
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 8

Stress: 1. tsf



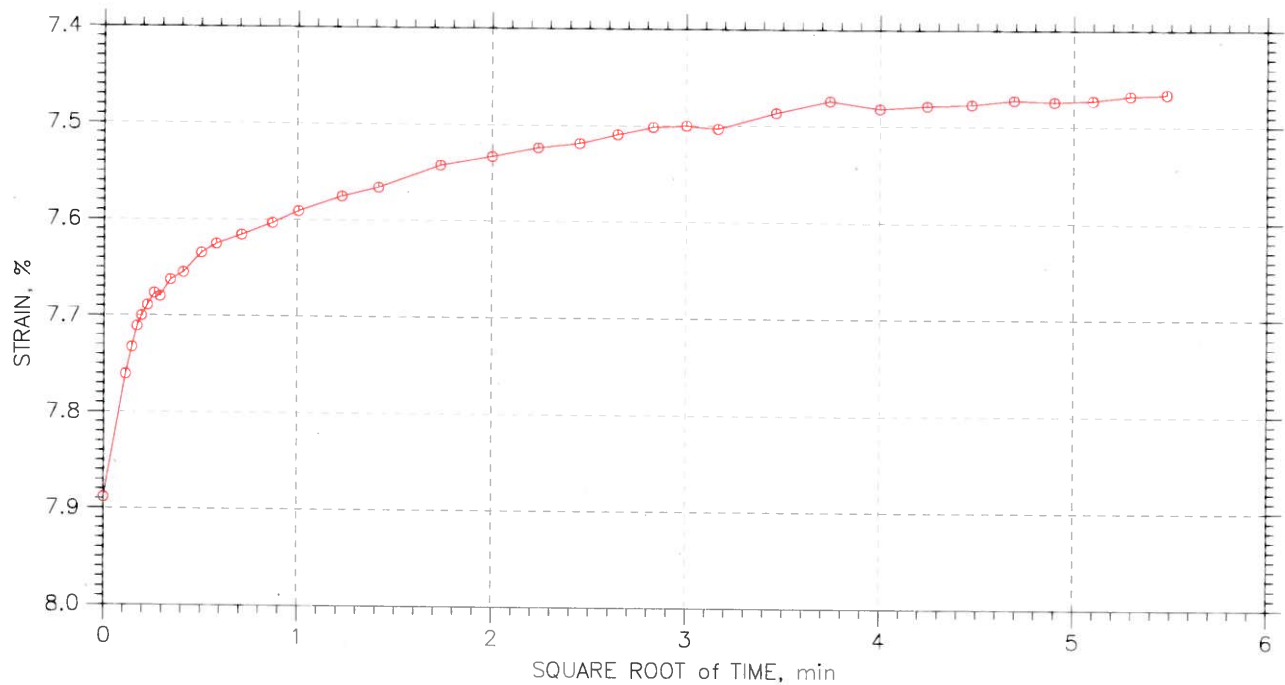
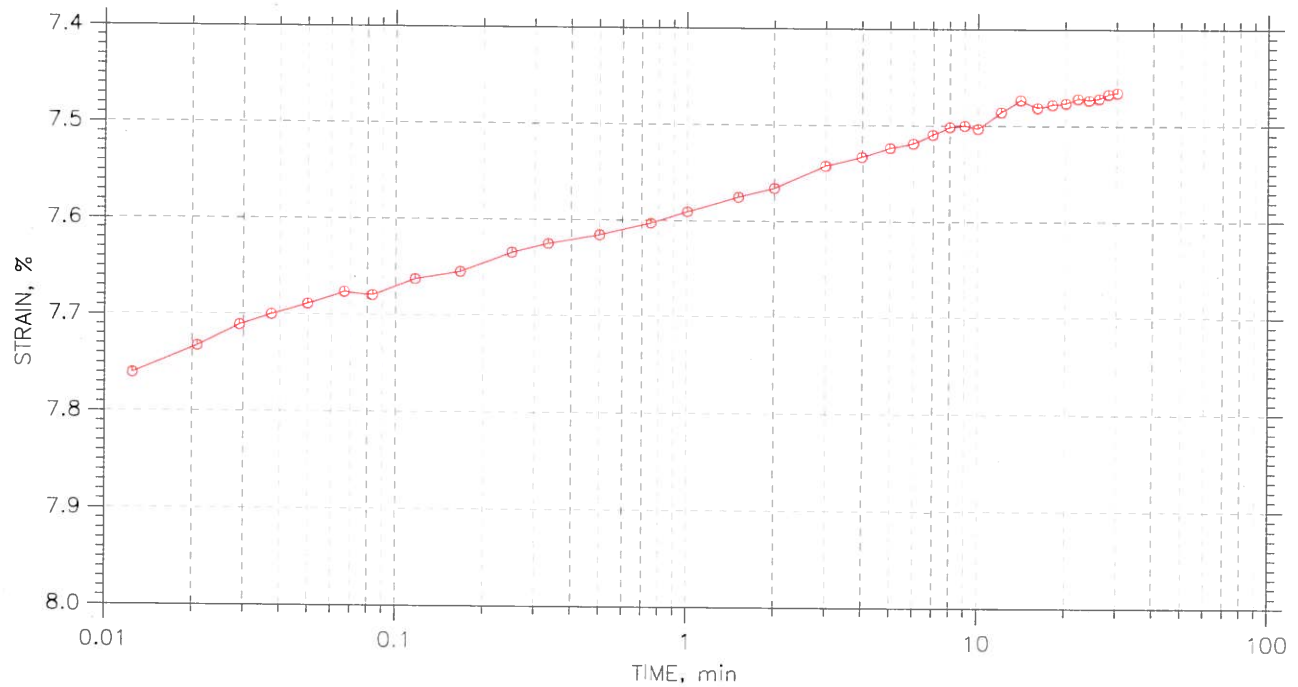
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 8

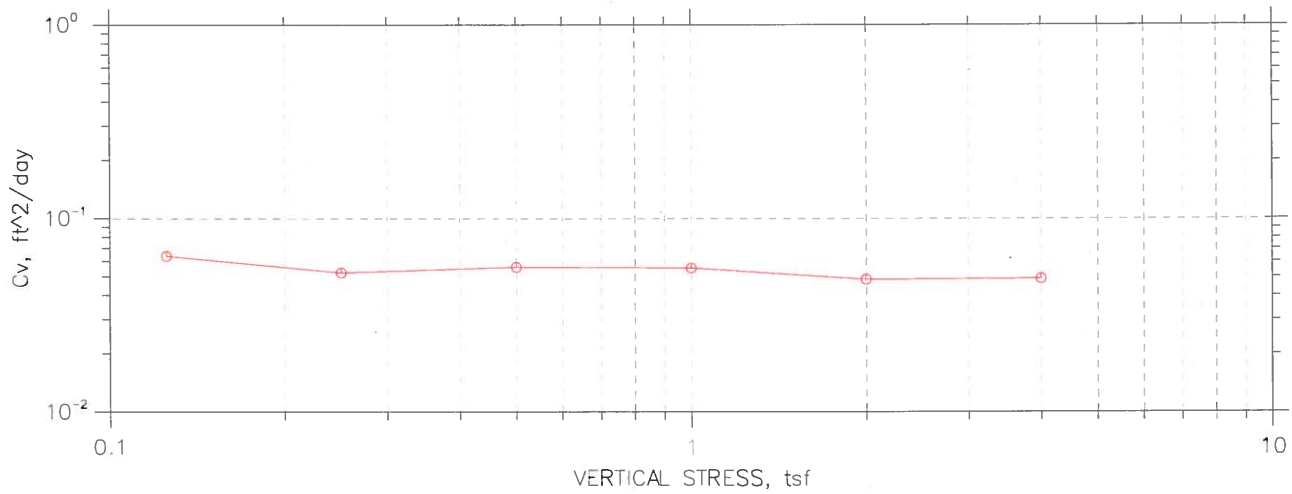
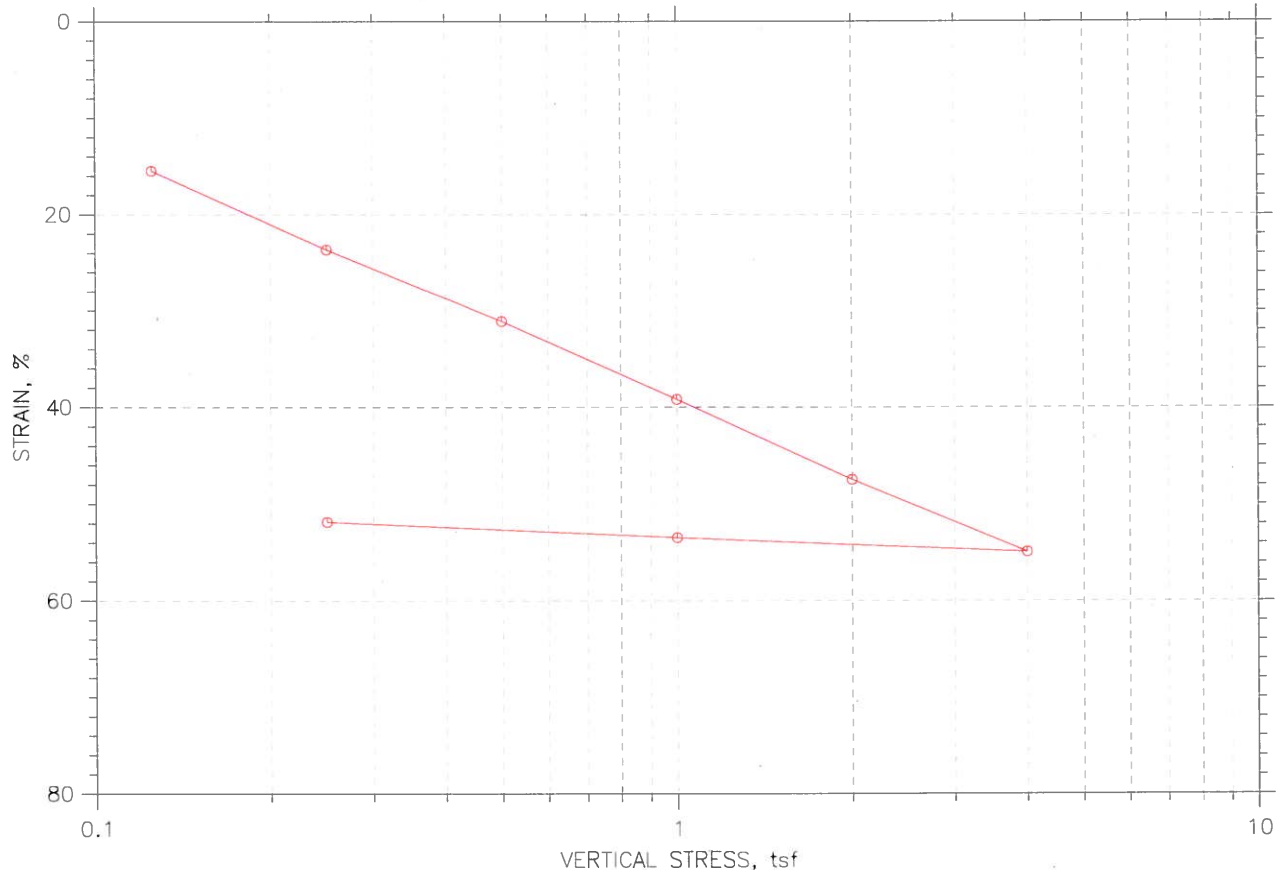
Stress: 0.25 tsf



GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: 0229-023	Test Date: 10-28-07	Depth: ---
	Test No.: 21679	Sample Type: Mix	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

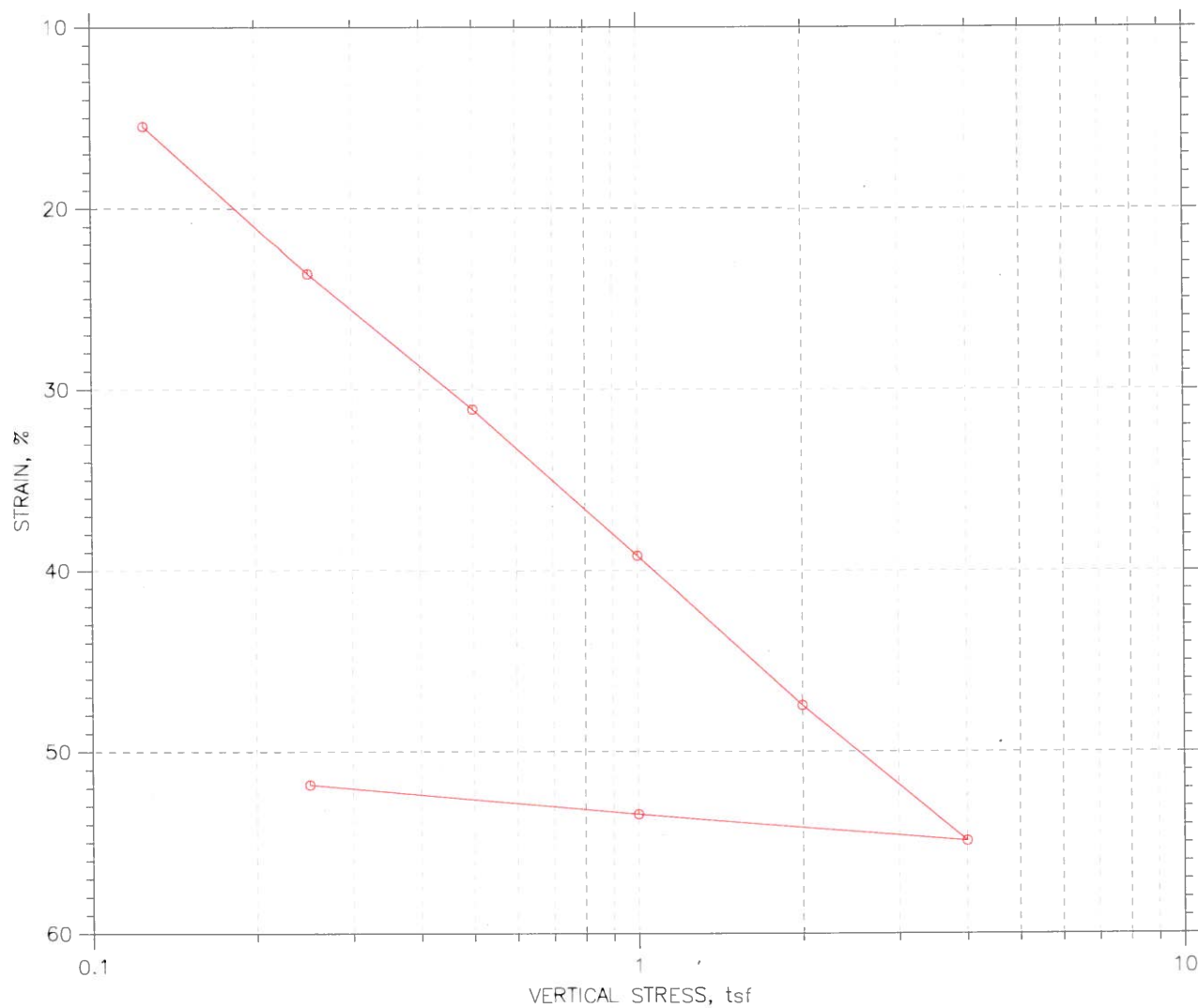
CONSOLIDATION TEST DATA

SUMMARY REPORT



GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 tsf				480.44	144.50
Preconsolidation Pressure: 0 tsf				11.91	24.72
Compression Index: 0				98.89	67.51
Diameter: 2.5 in	Height: 1 in			12.63	5.57
LL: NP	PL: NP	PI: NP	GS: 2.60		

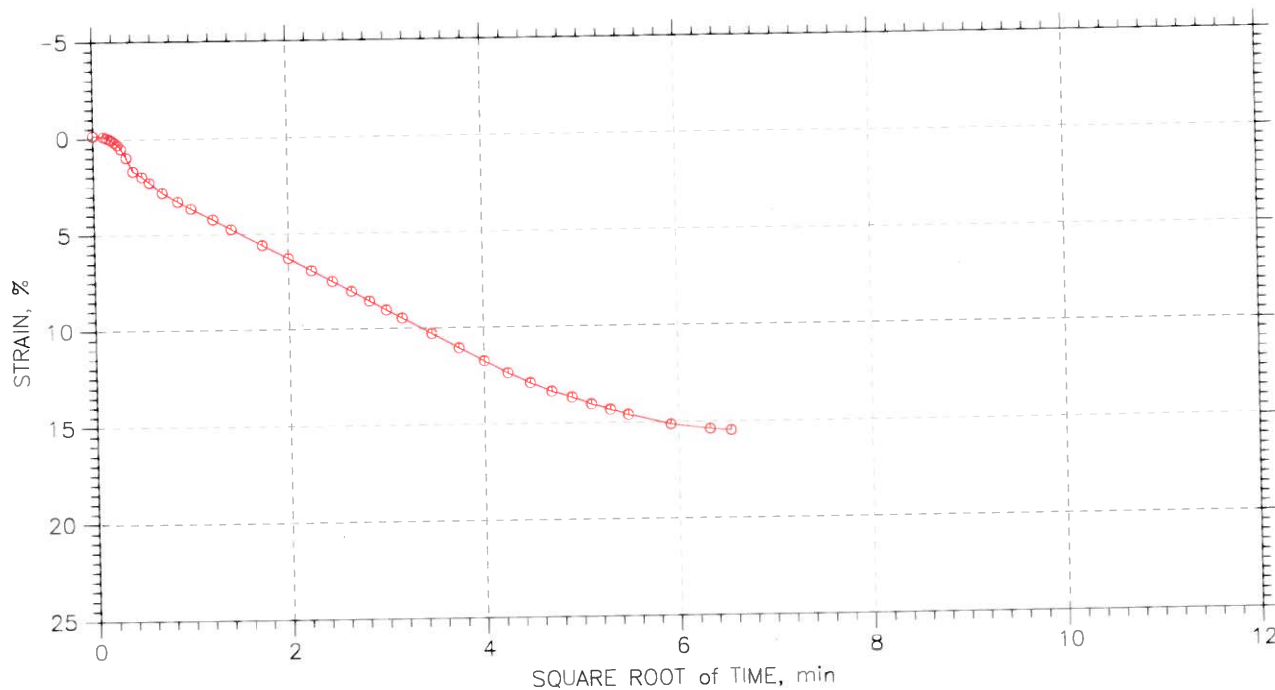
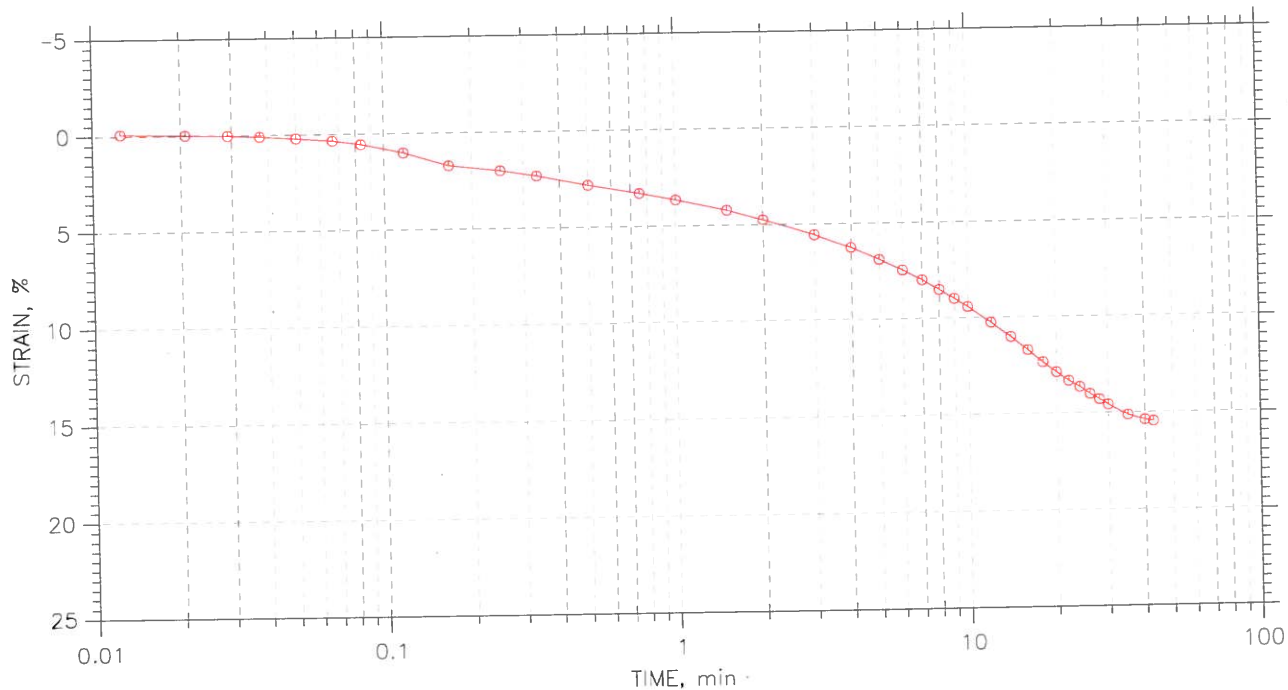
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: co
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 8

Stress: 0.125 tsf



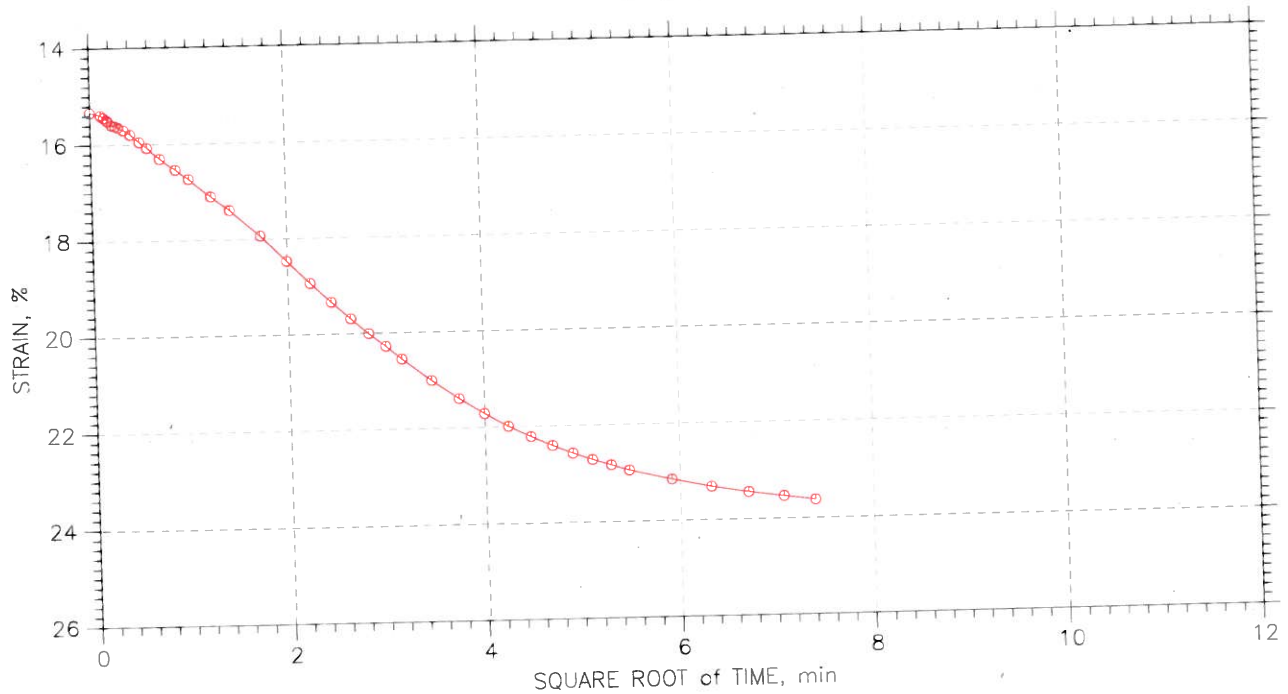
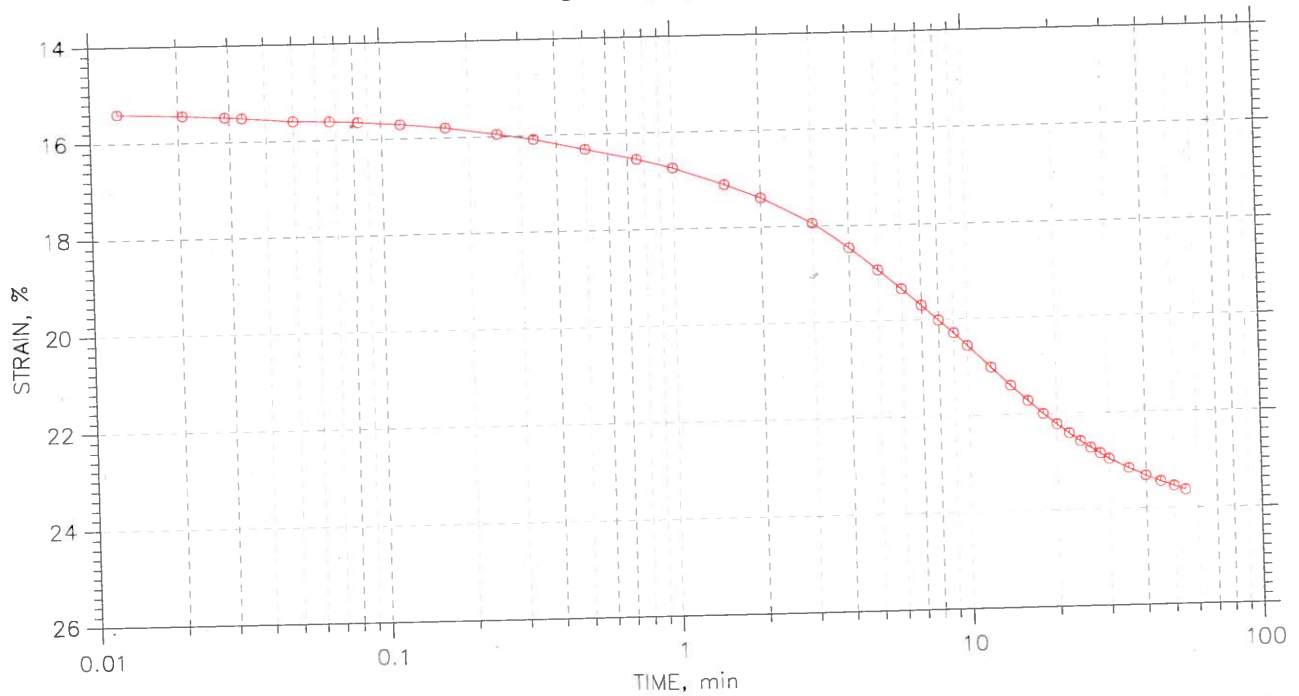
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 8

Stress: 0.25 tsf



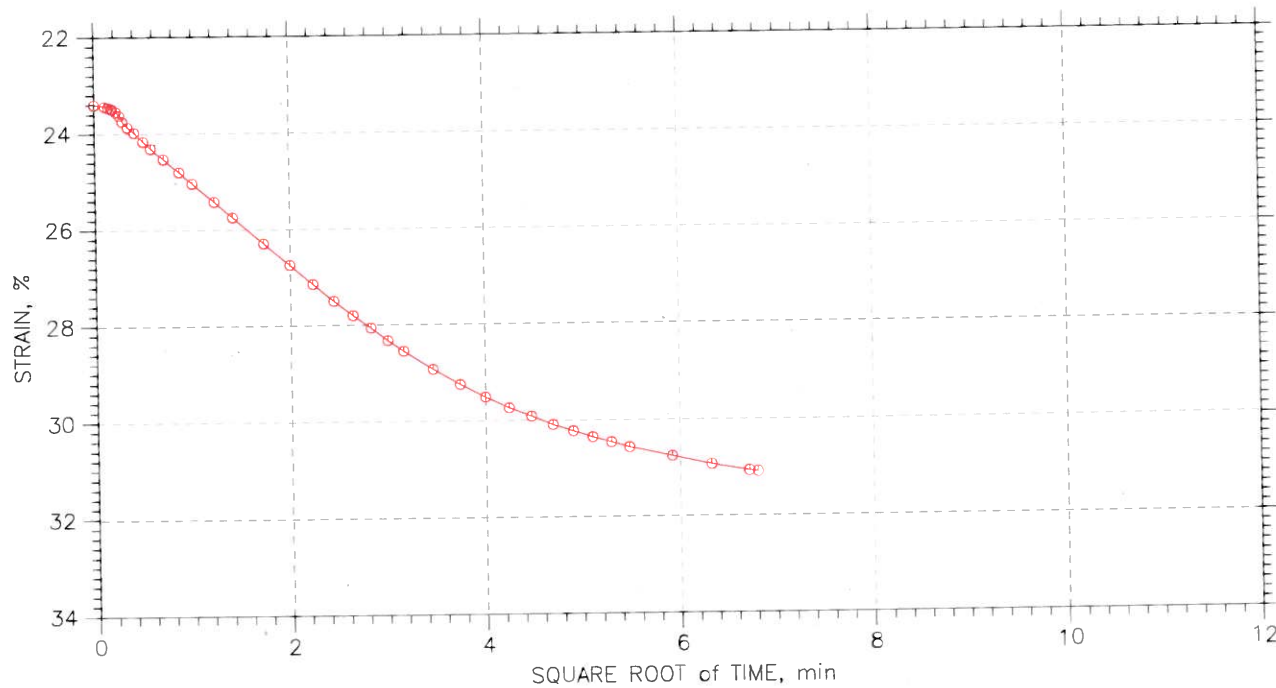
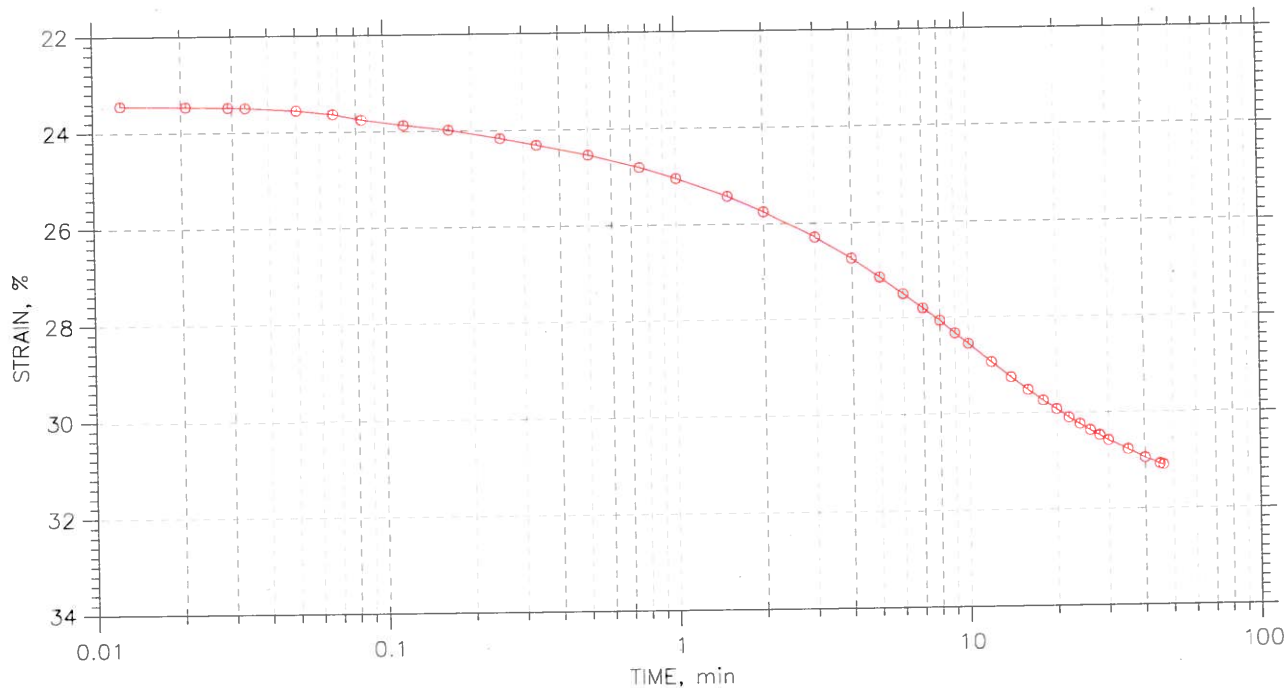
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 8

Stress: 0.5 tsf



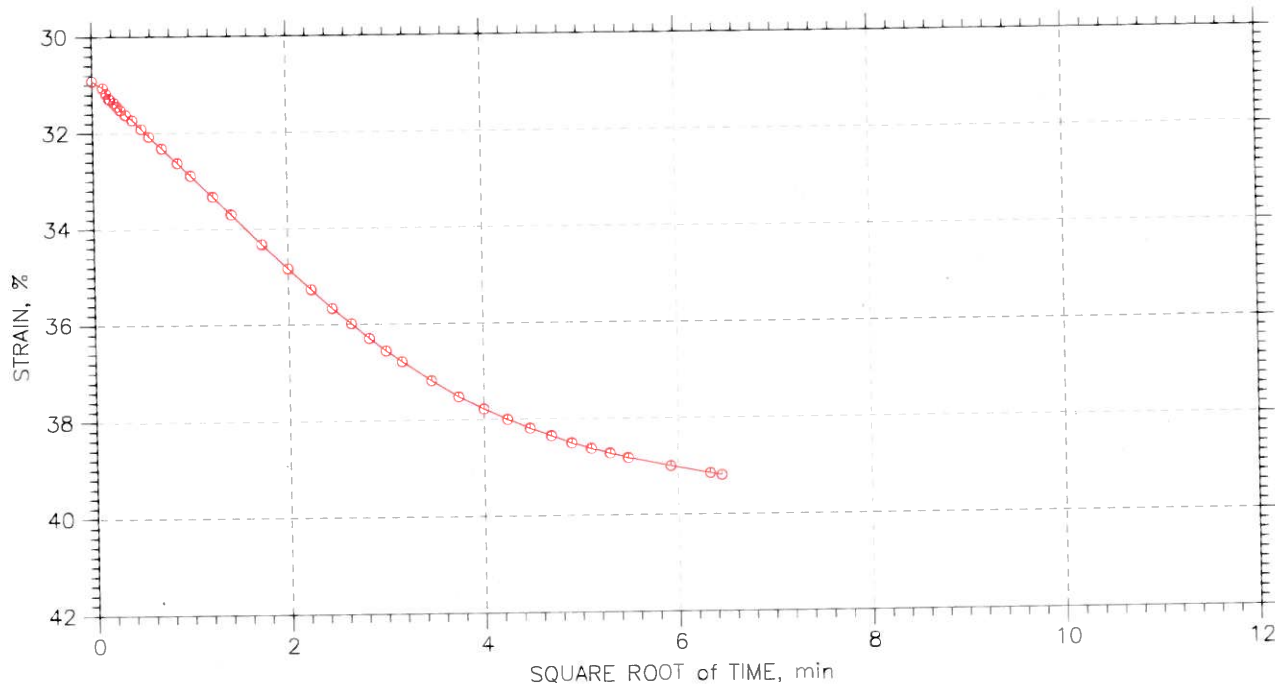
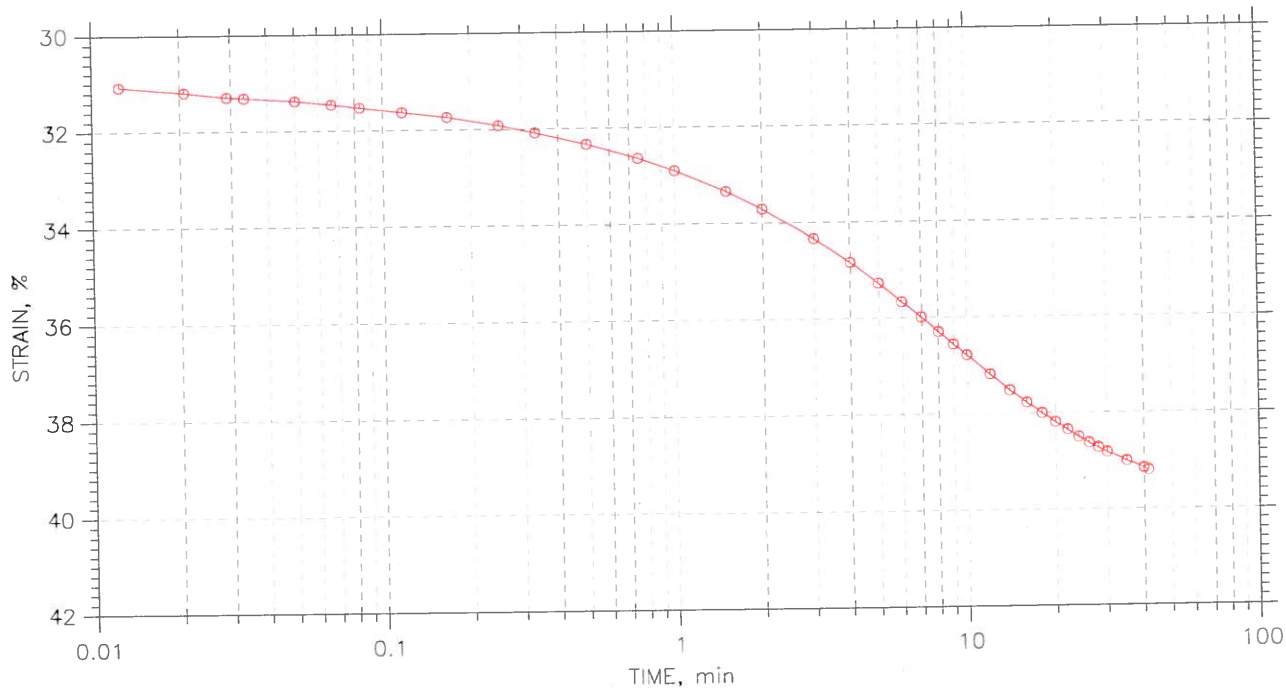
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 8

Stress: 1. tsf



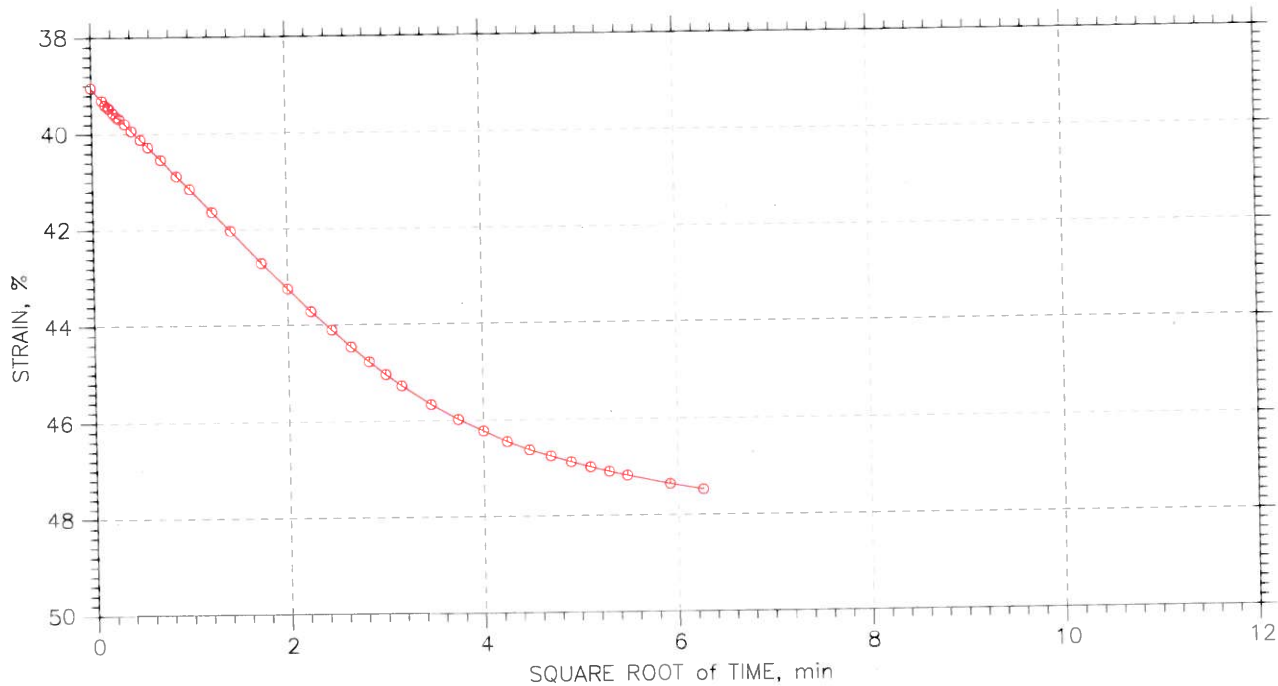
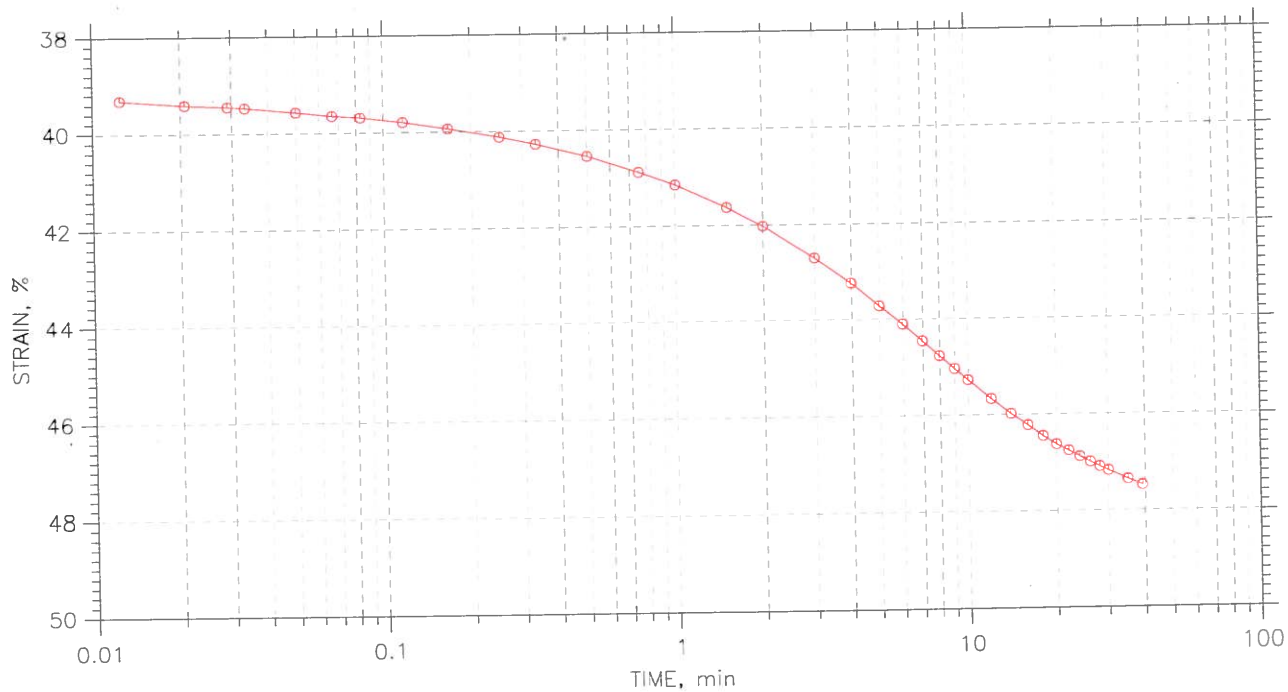
GeoTesting express <i>the groundwork for success</i>	Project: Lagoqn Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 8

Stress: 2. tsf



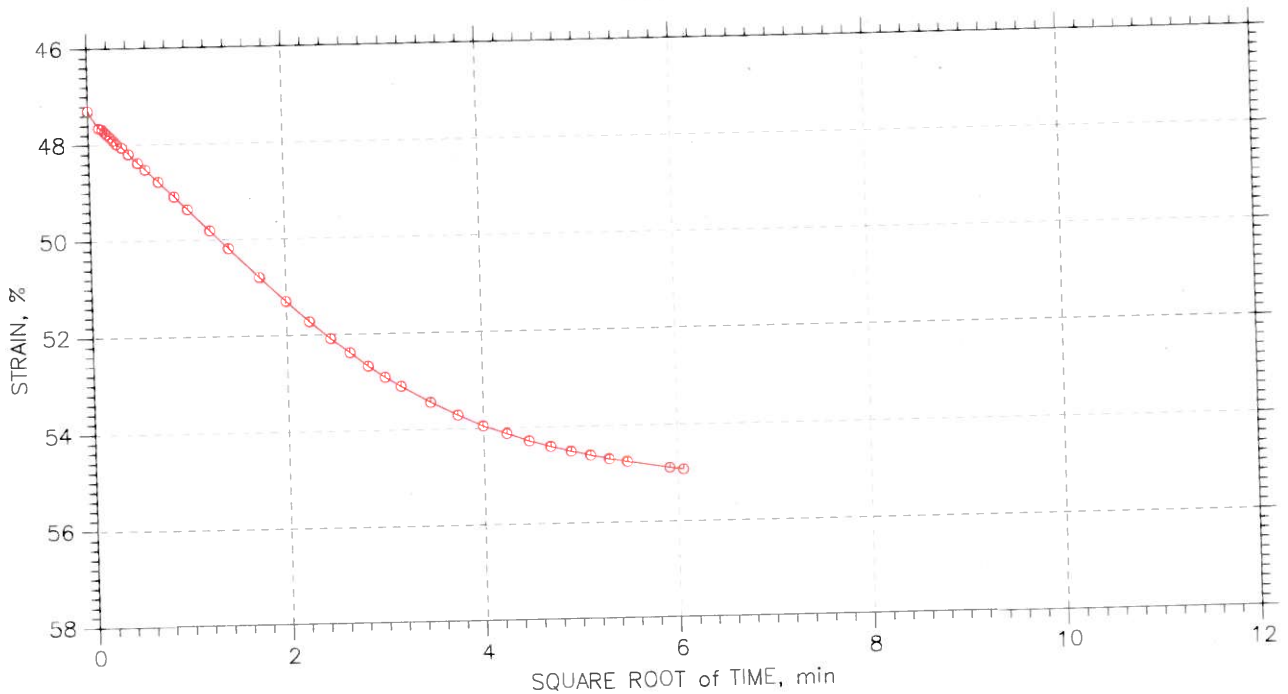
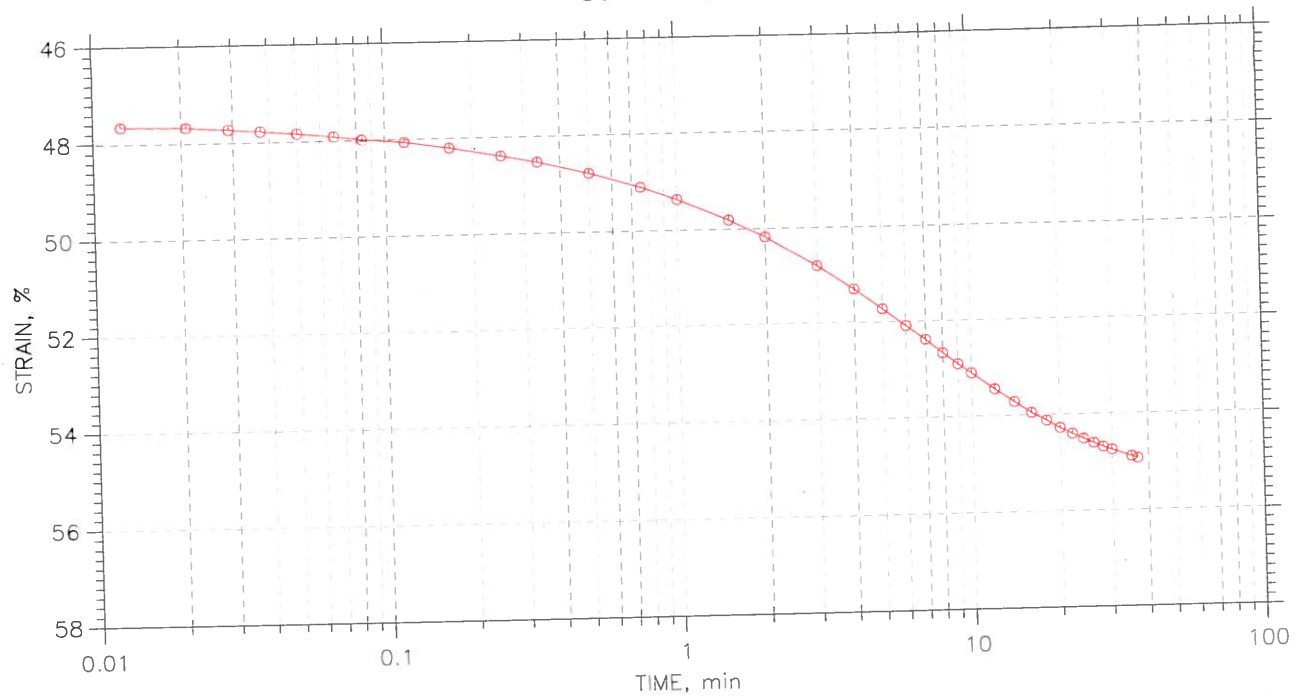
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 8

Stress: 4. tsf



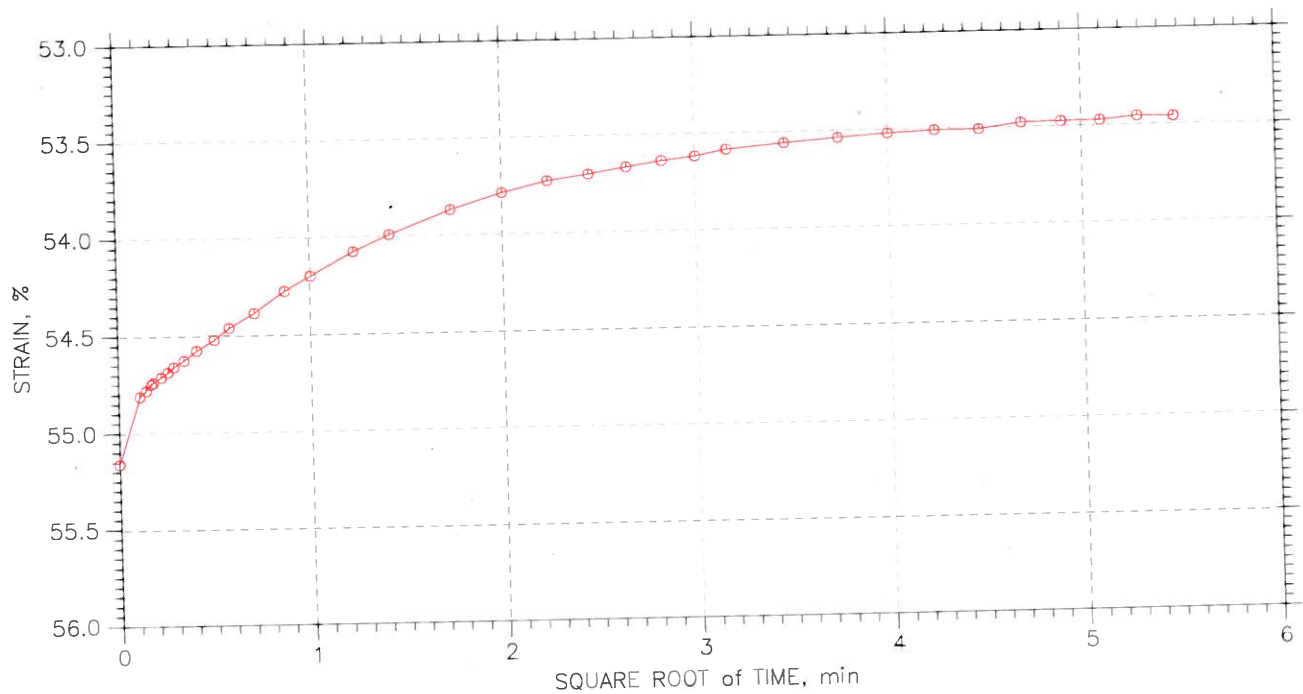
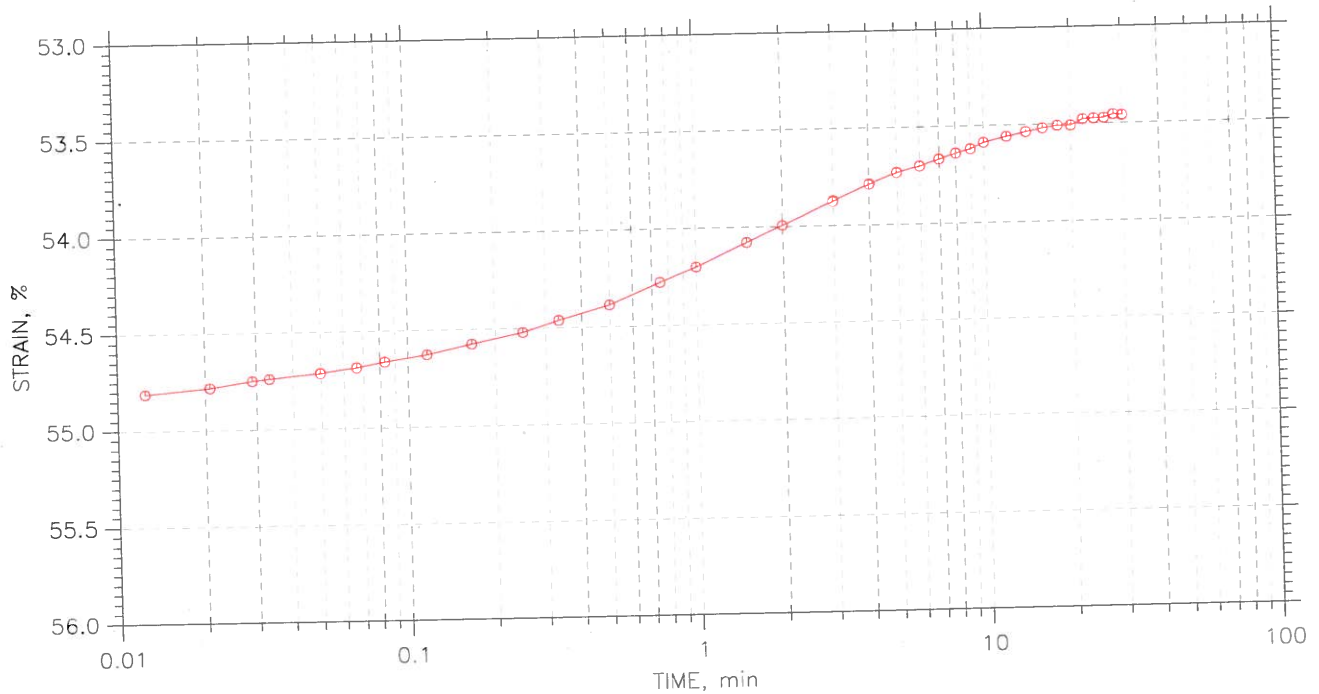
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 8

Stress: 1. tsf



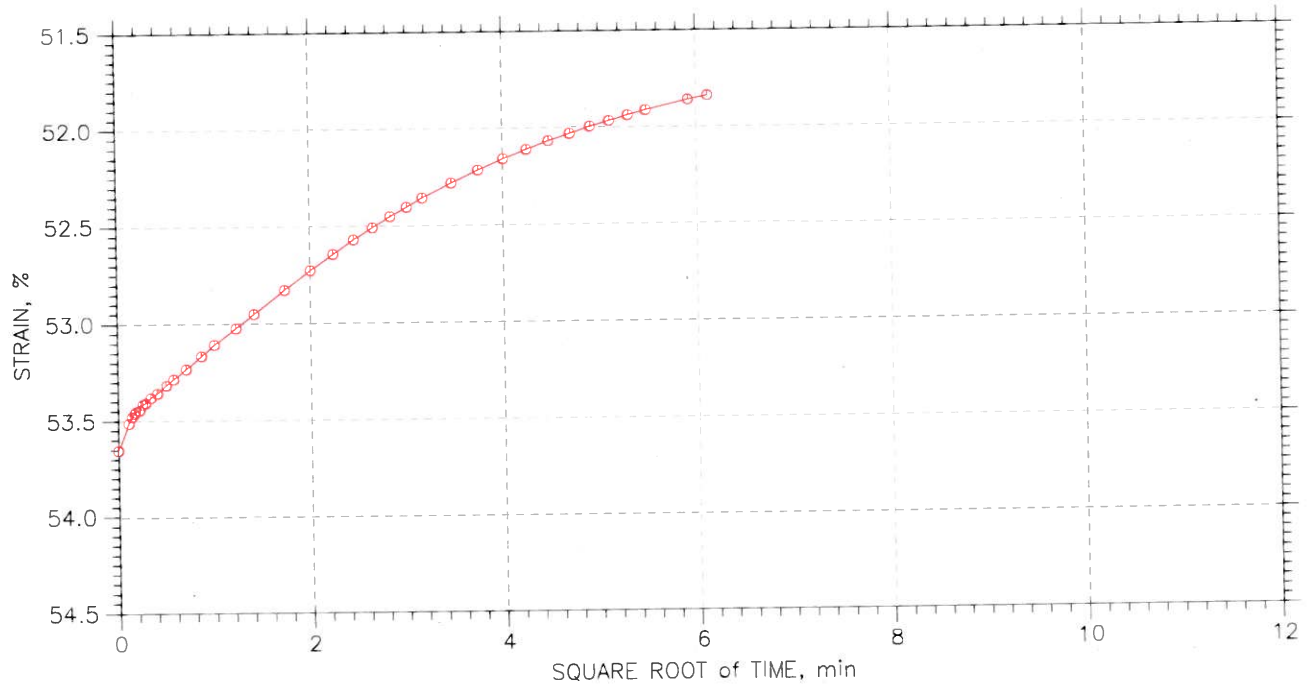
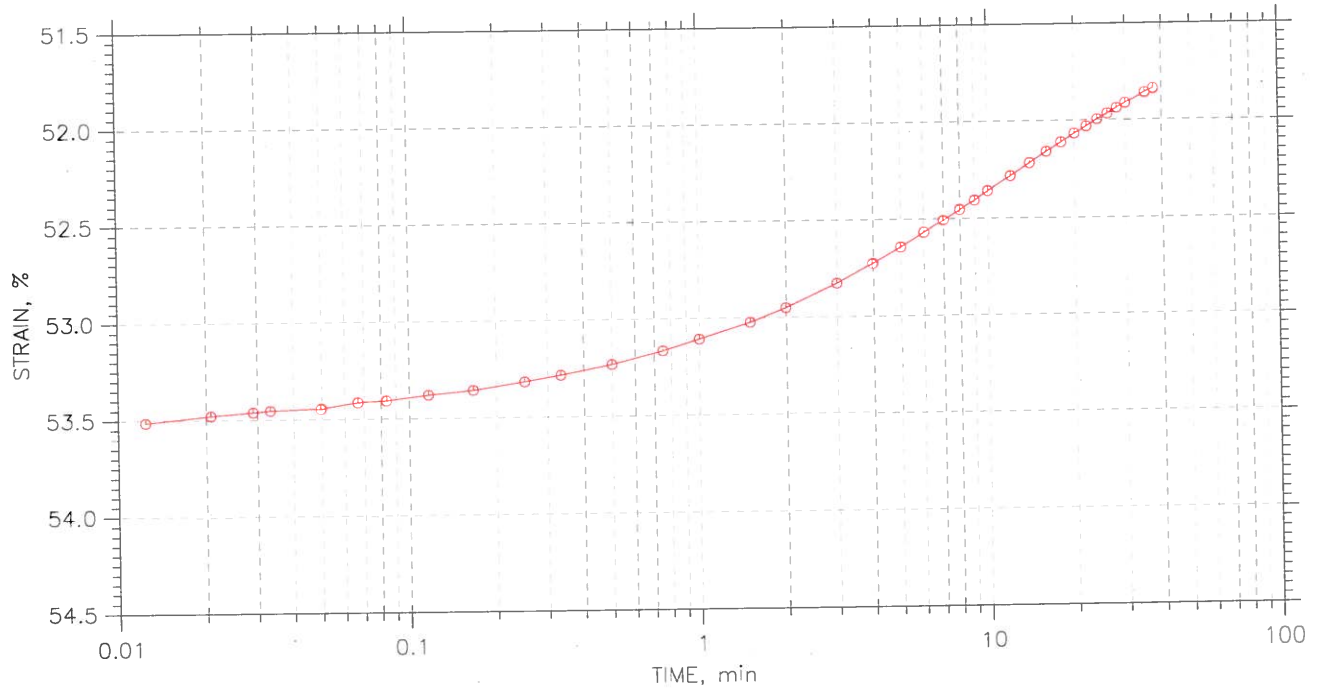
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 8

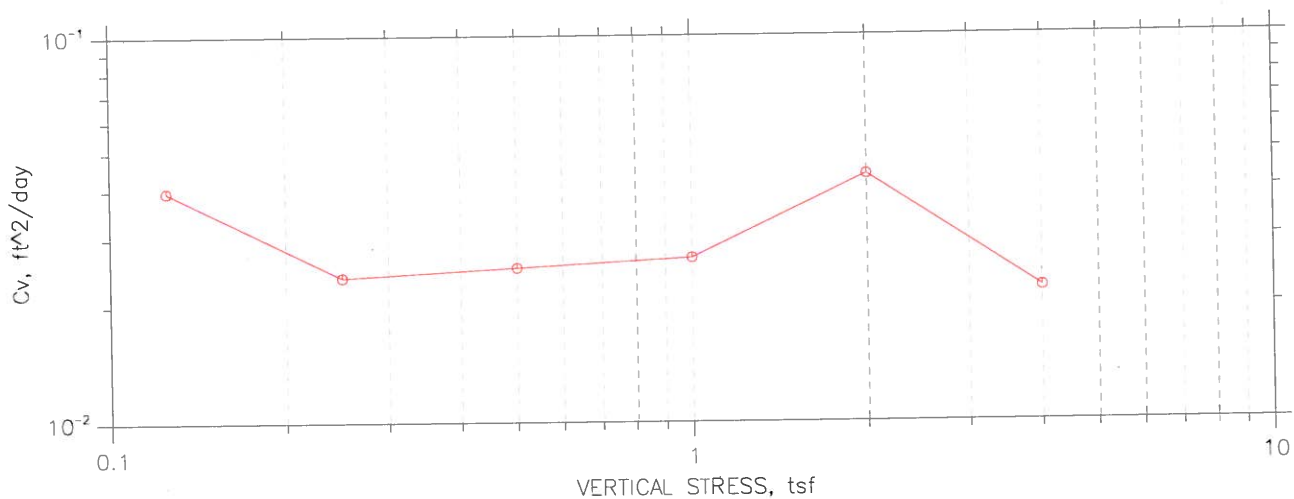
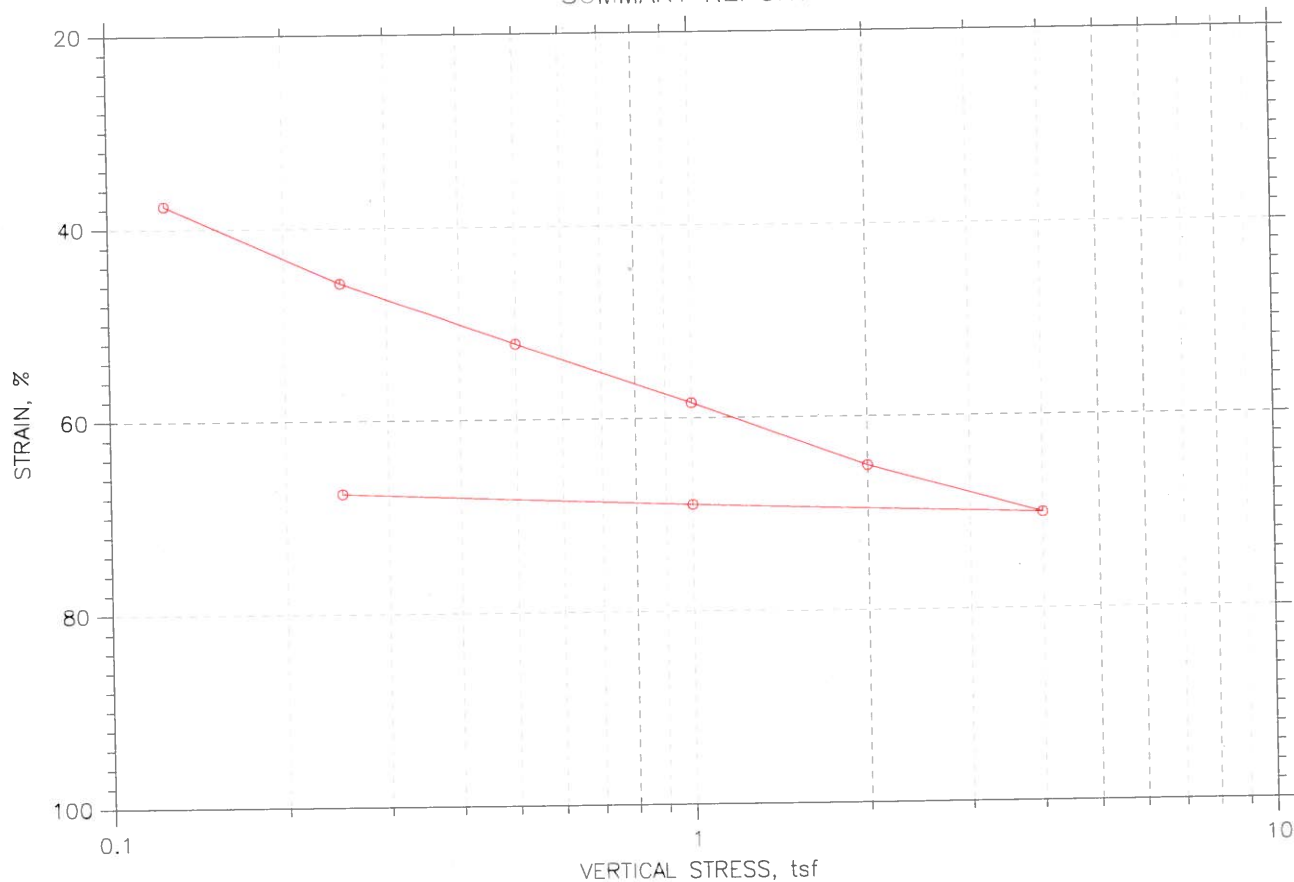
Stress: 0.25 tsf



GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-1	Test Date: 10-30-07	Depth: ---
	Test No.: 21680	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

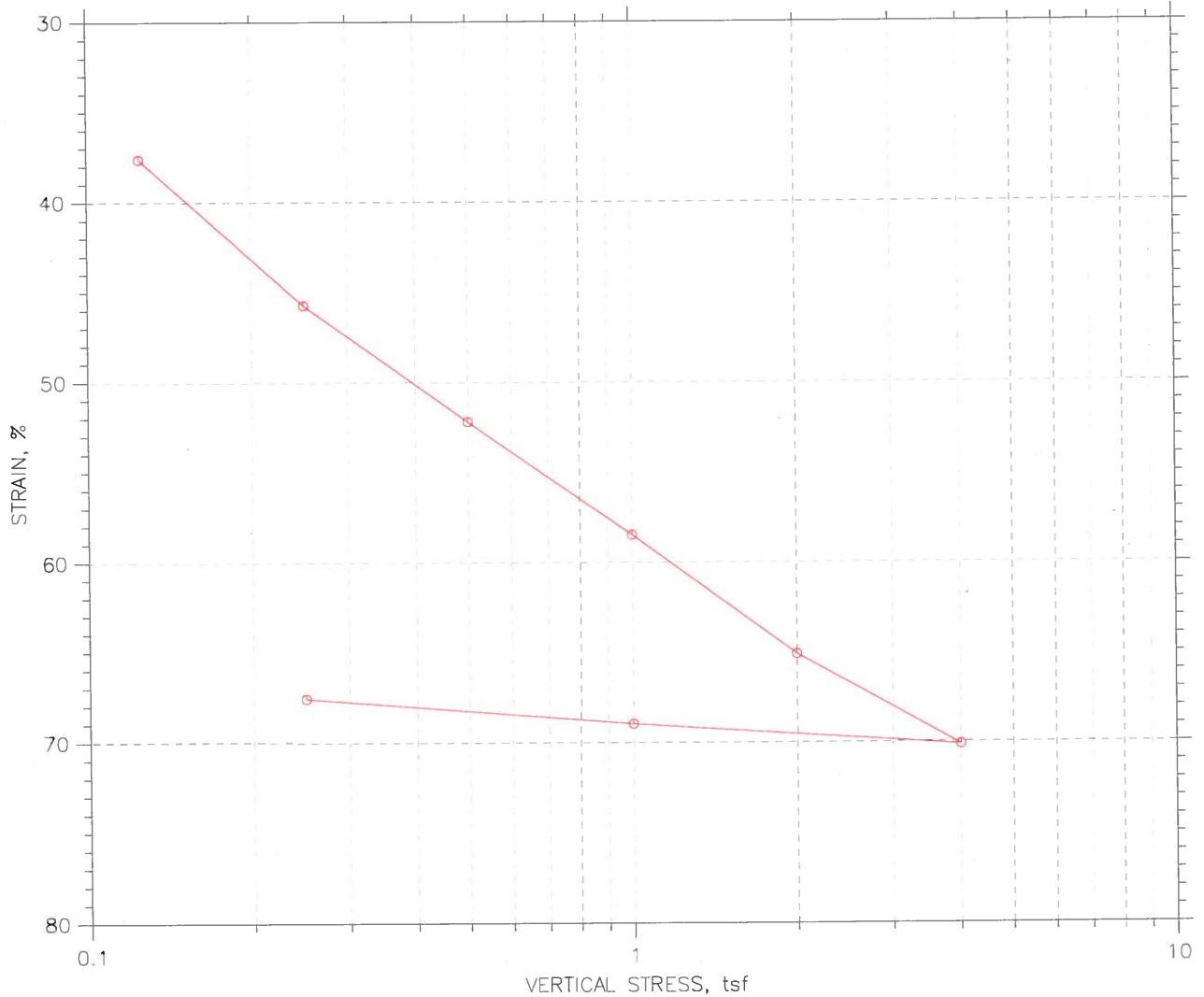
SUMMARY REPORT



GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-2	Test Date: 10-31-07	Depth: ---
	Test No.: 21681	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

SUMMARY REPORT



		Before Test	After Test
Overburden Pressure: 0 tsf		Water Content, %	347.96
Preconsolidation Pressure: 0 tsf		Dry Unit Weight, pcf	15.63
Compression Index: 0		Saturation, %	96.40
Diameter: 2.5 in	Height: 1 in	Void Ratio	
LL: NP	PL: NP	PI: NP	GS: 2.60

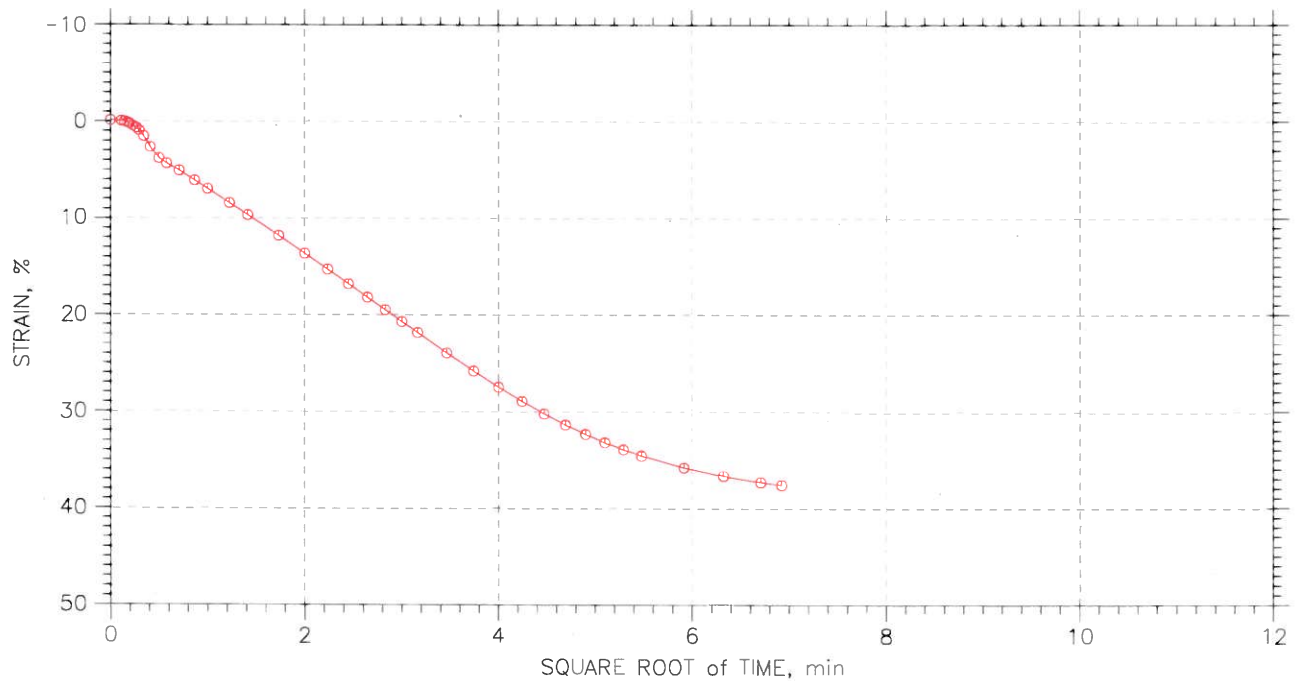
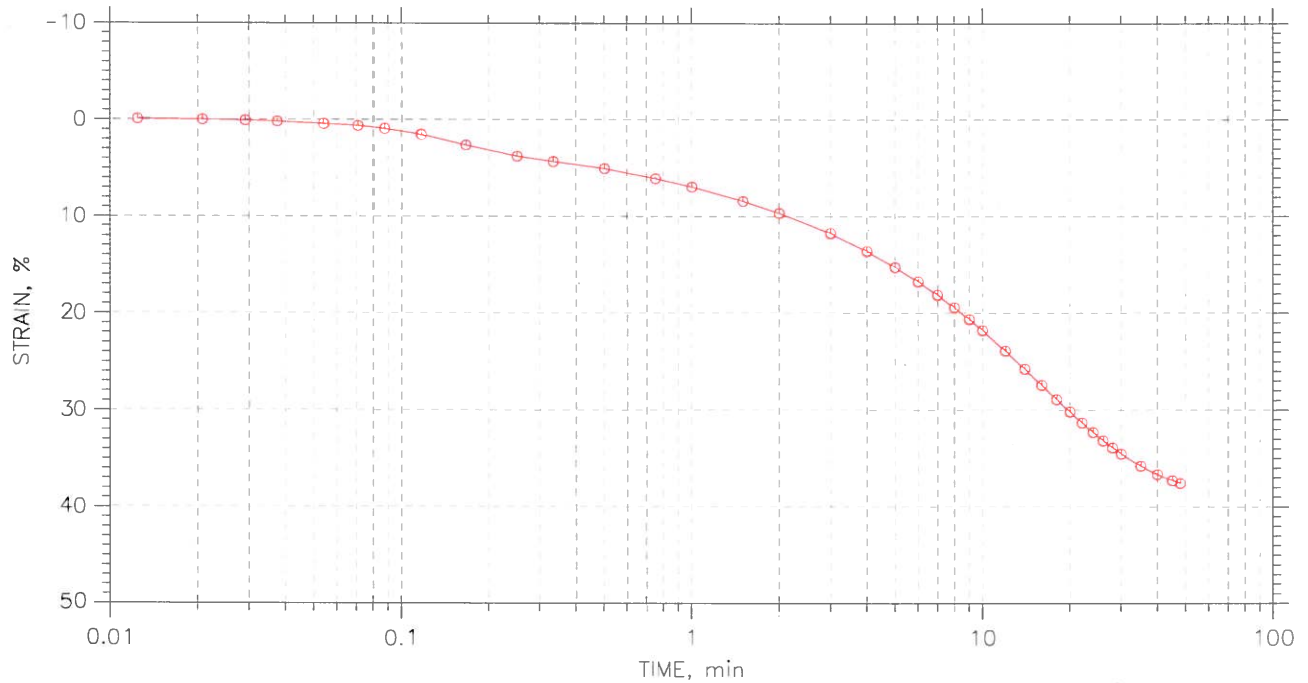
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-2	Test Date: 10-31-07	Depth: ---
	Test No.: 21681	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 8

Stress: 0.125 tsf



GeoTesting
express
the groundwork for success

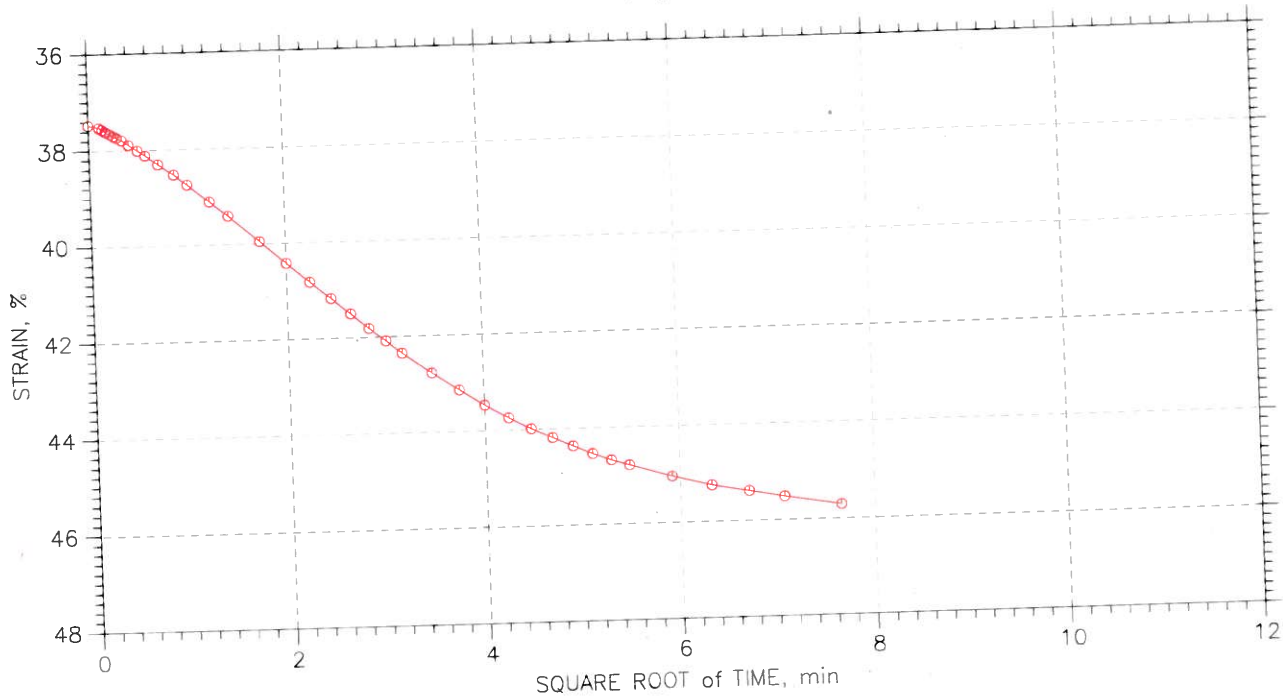
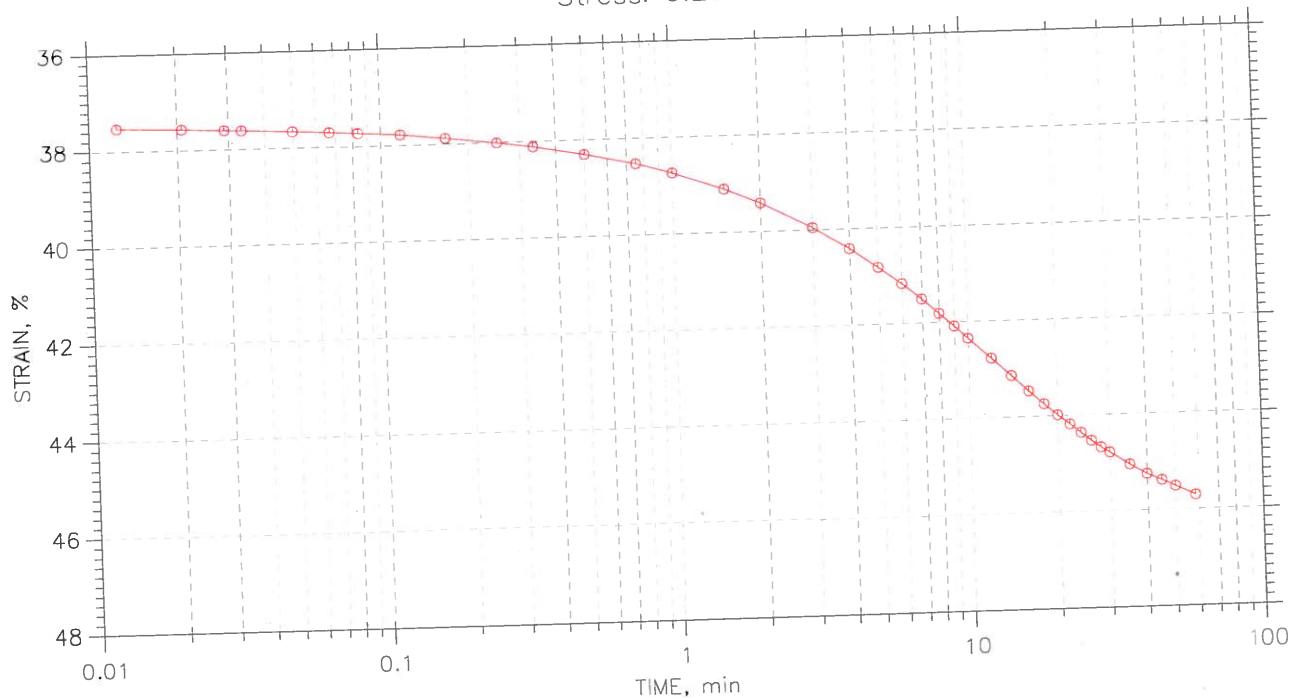
Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
Boring No.: ---	Tested By: mm	Checked By: ca
Sample No.: L-2	Test Date: 10-31-07	Depth: ---
Test No.: 21681	Sample Type: Untreated	Elevation: ---
Description: Stabilized Soil		
Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 8

Stress: 0.25 tsf



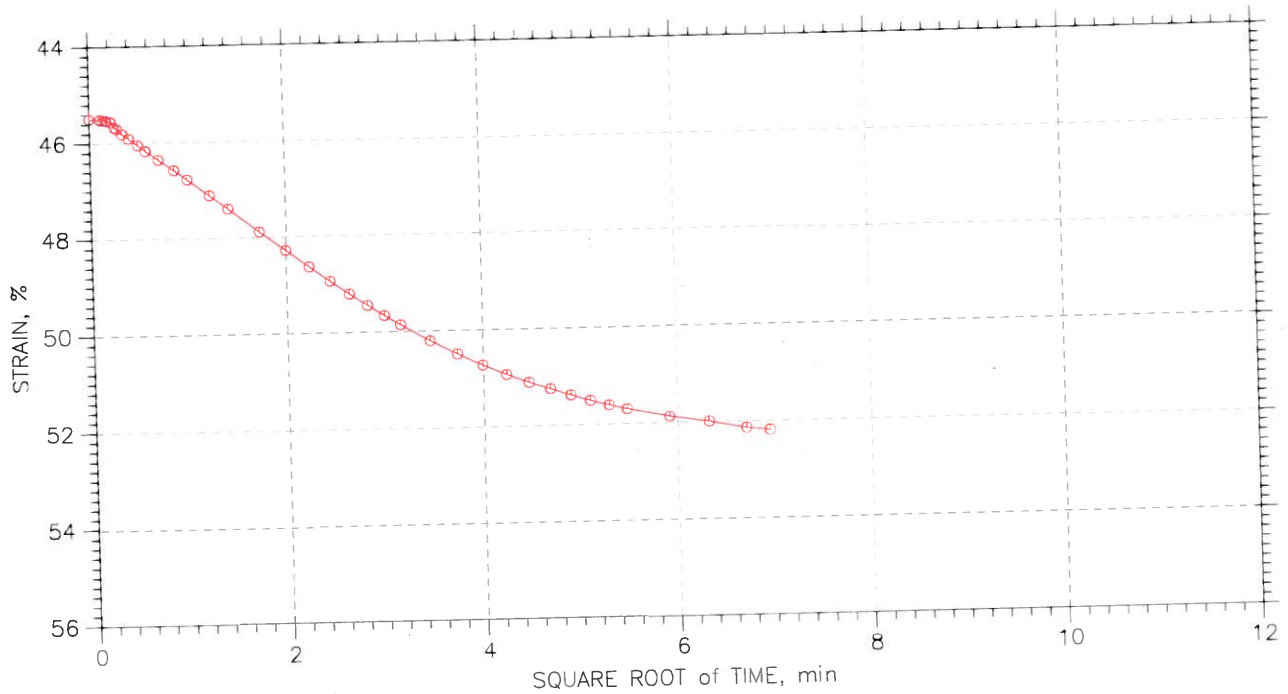
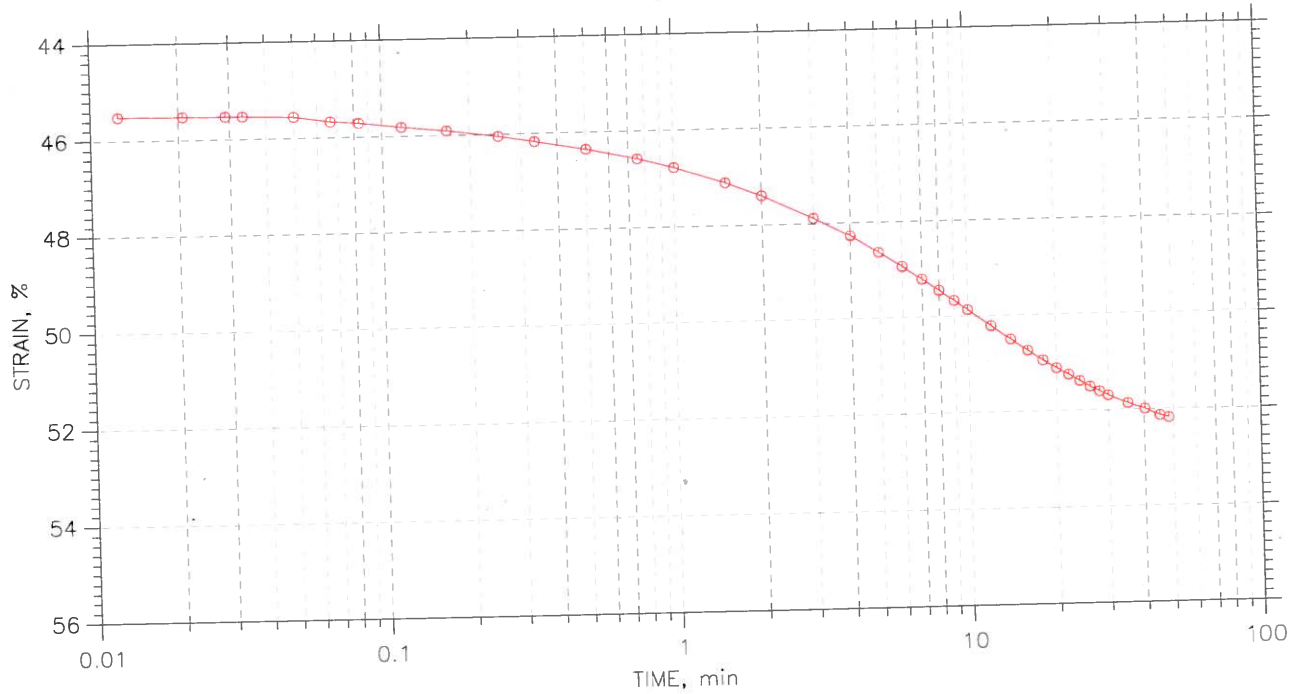
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-2	Test Date: 10-31-07	Depth: ---
	Test No.: 21681	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 8

Stress: 0.5 tsf



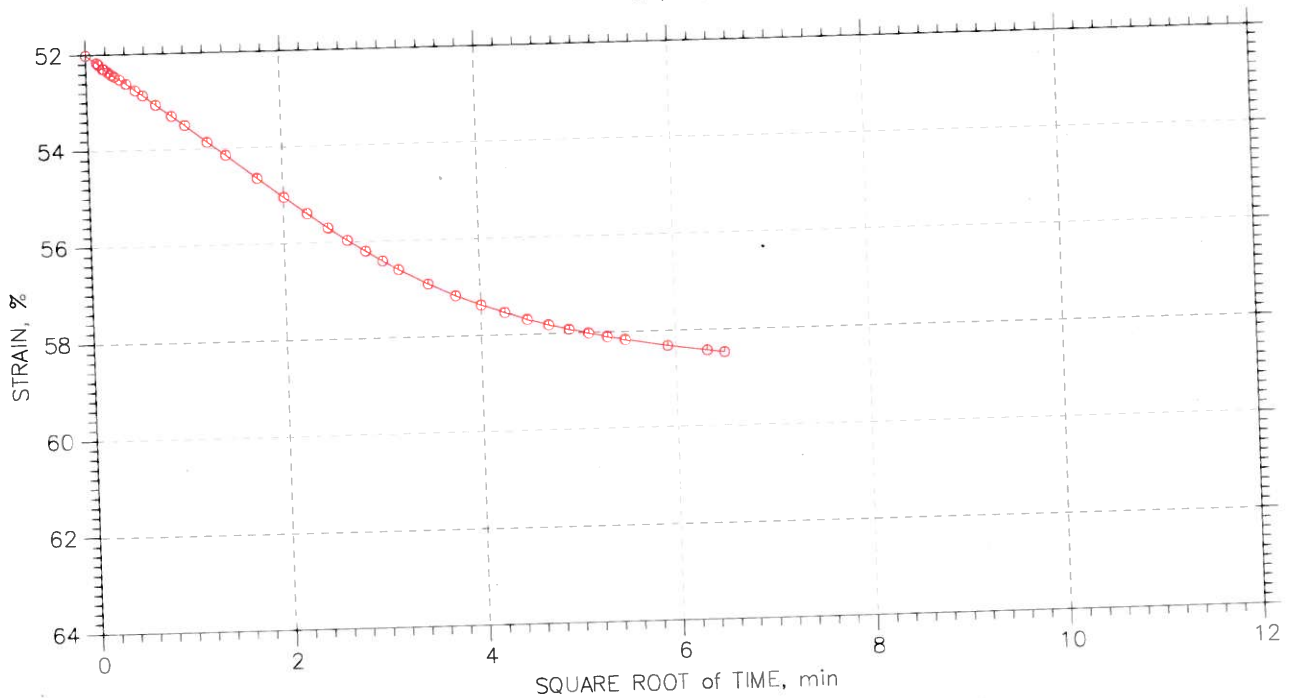
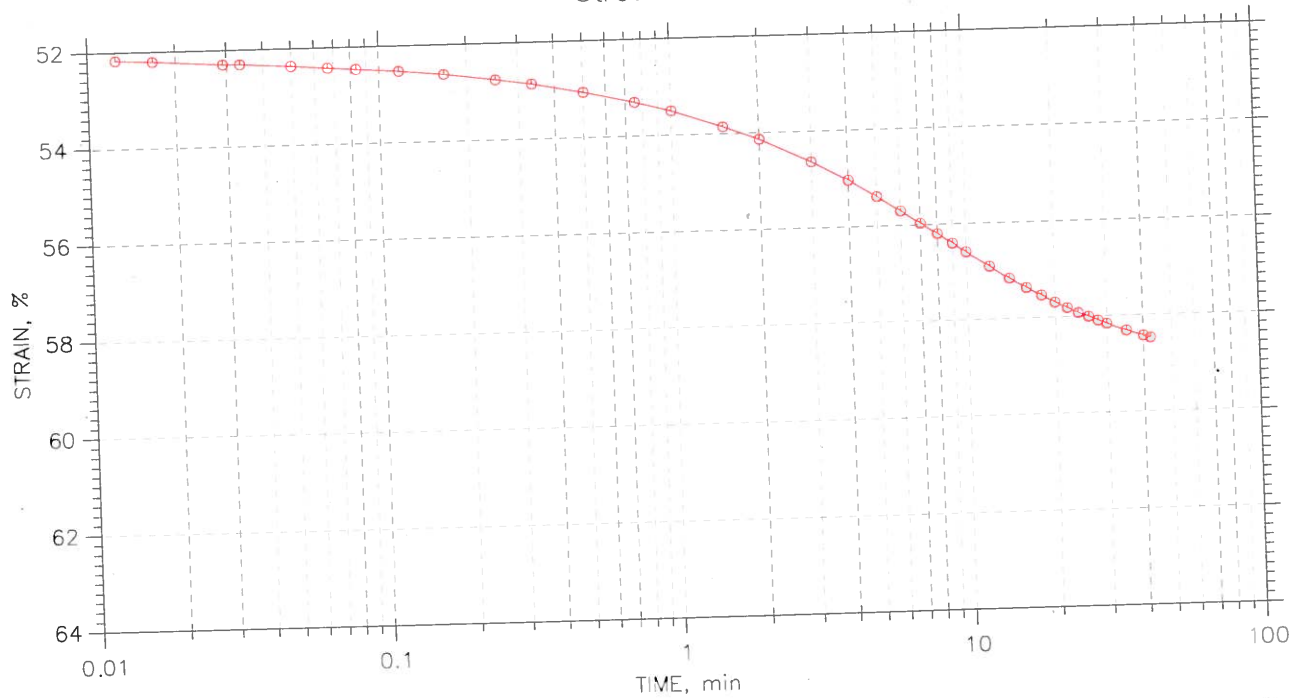
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-2	Test Date: 10-31-07	Depth: ---
	Test No.: 21681	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 8

Stress: 1. tsf



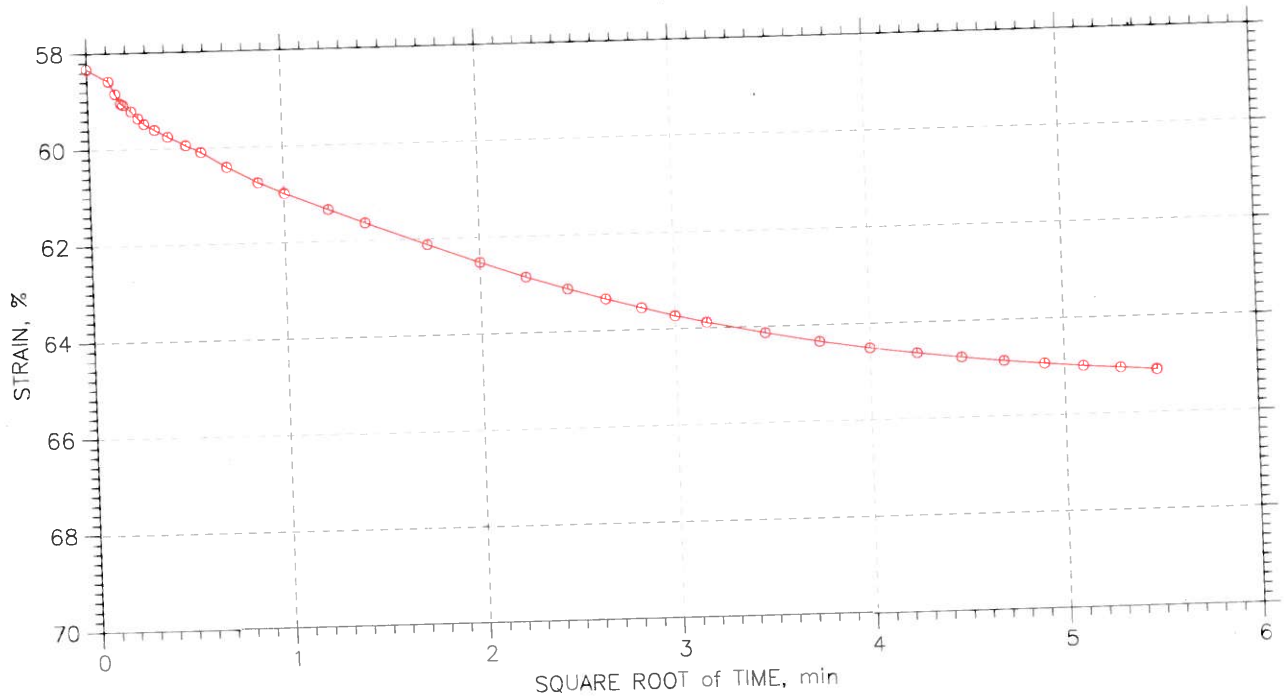
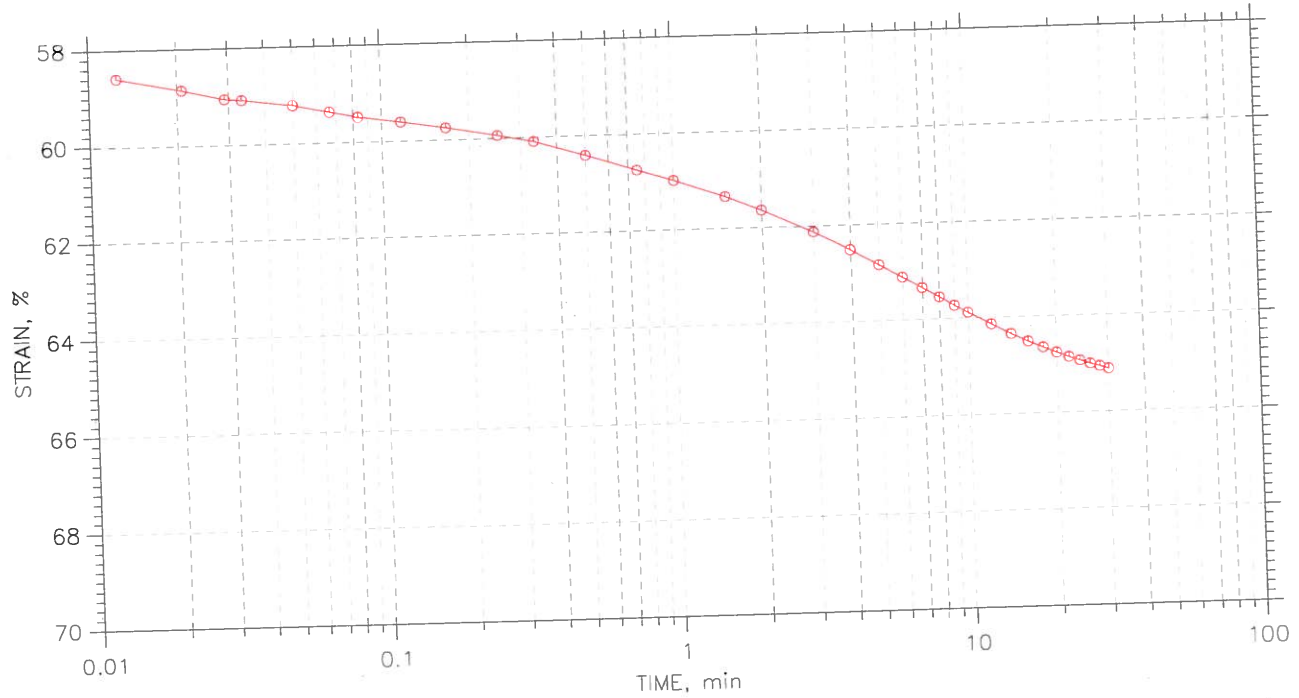
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-2	Test Date: 10-31-07	Depth: ---
	Test No.: 21681	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 8

Stress: 2. tsf



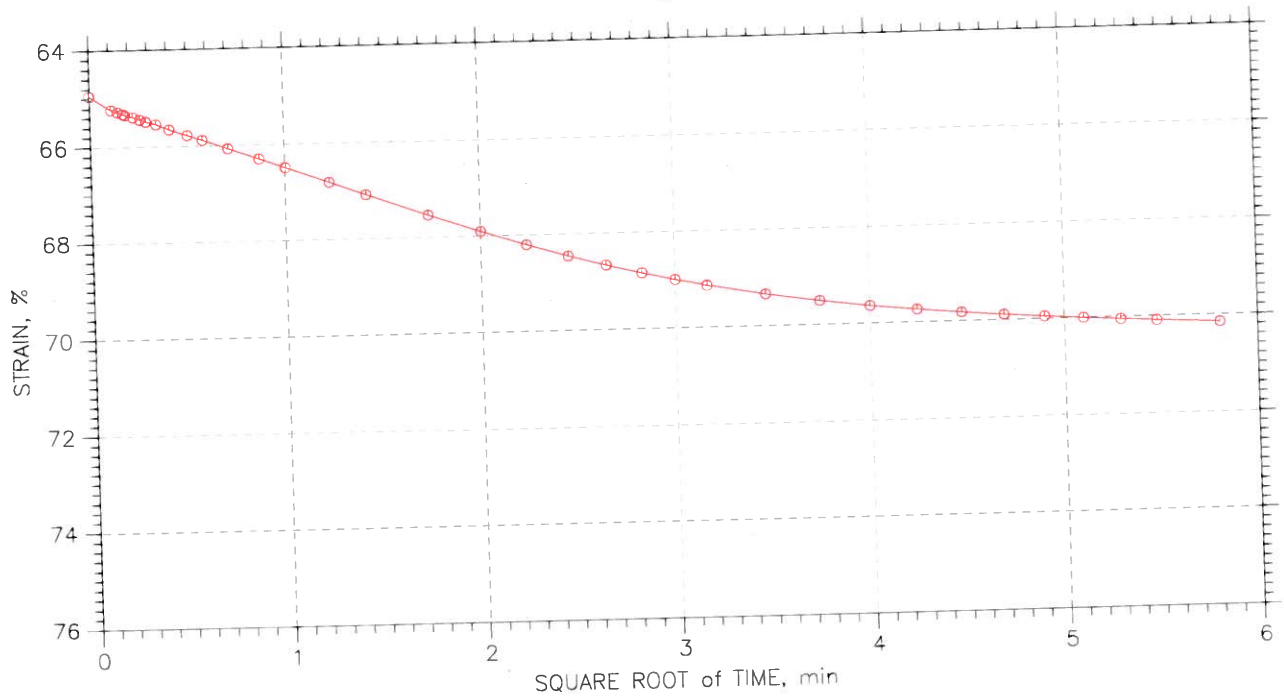
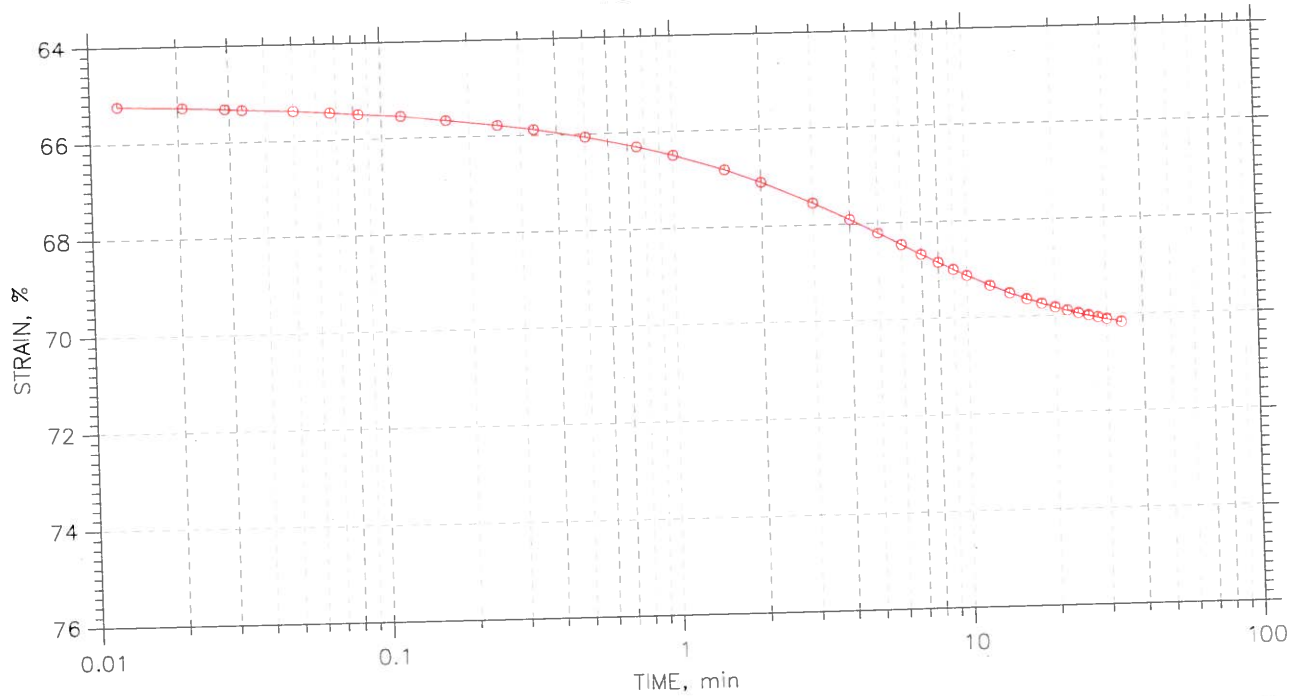
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-2	Test Date: 10-31-07	Depth: ---
	Test No.: 21681	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 8

Stress: 4. tsf



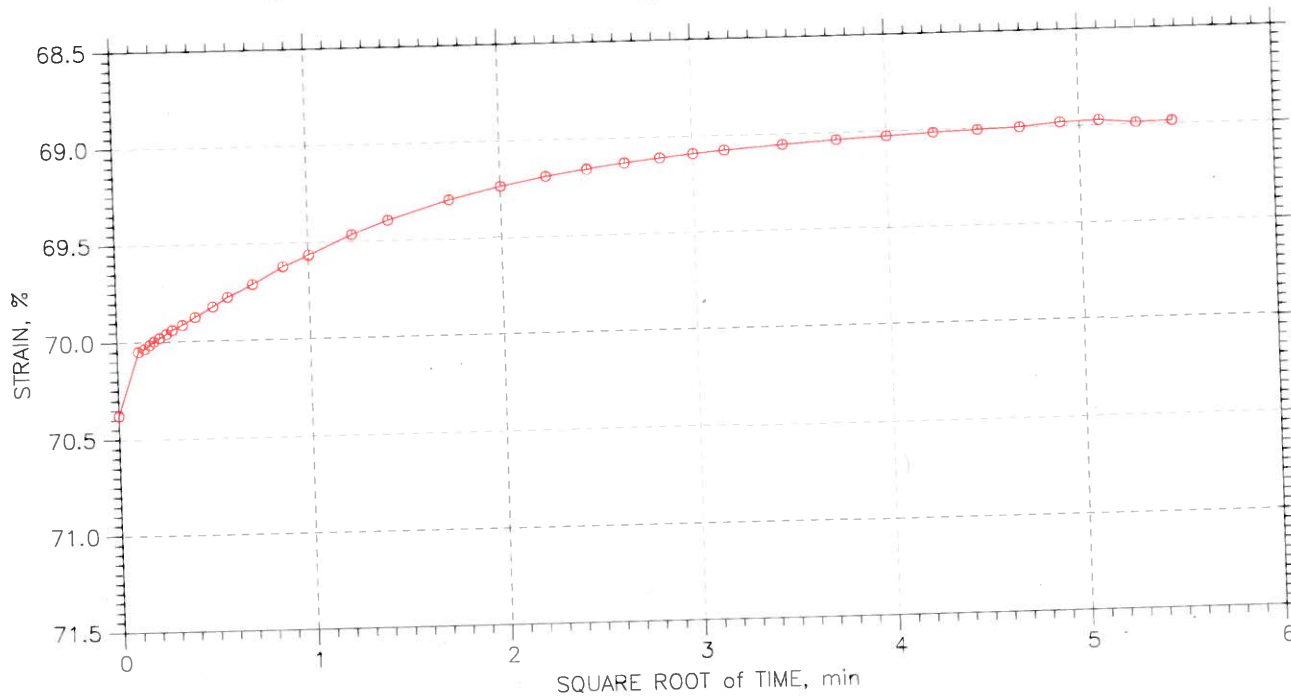
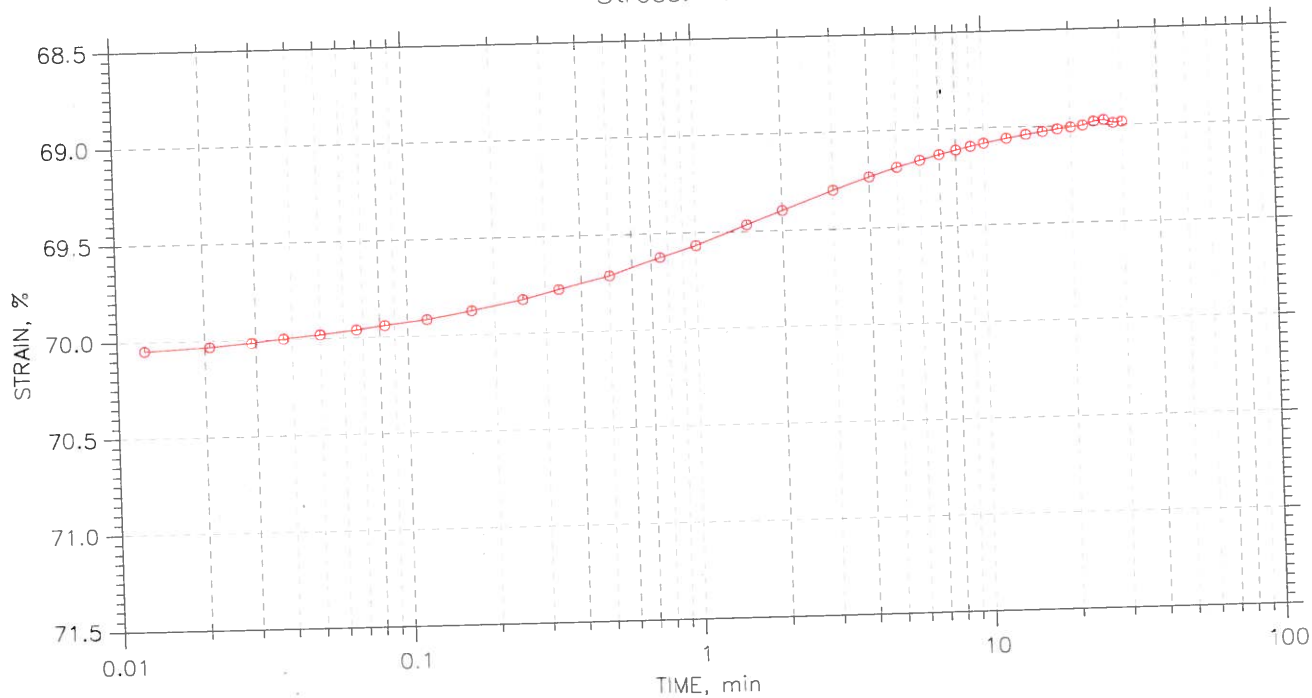
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-2	Test Date: 10-31-07	Depth: ---
	Test No.: 21681	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 8

Stress: 1. tsf



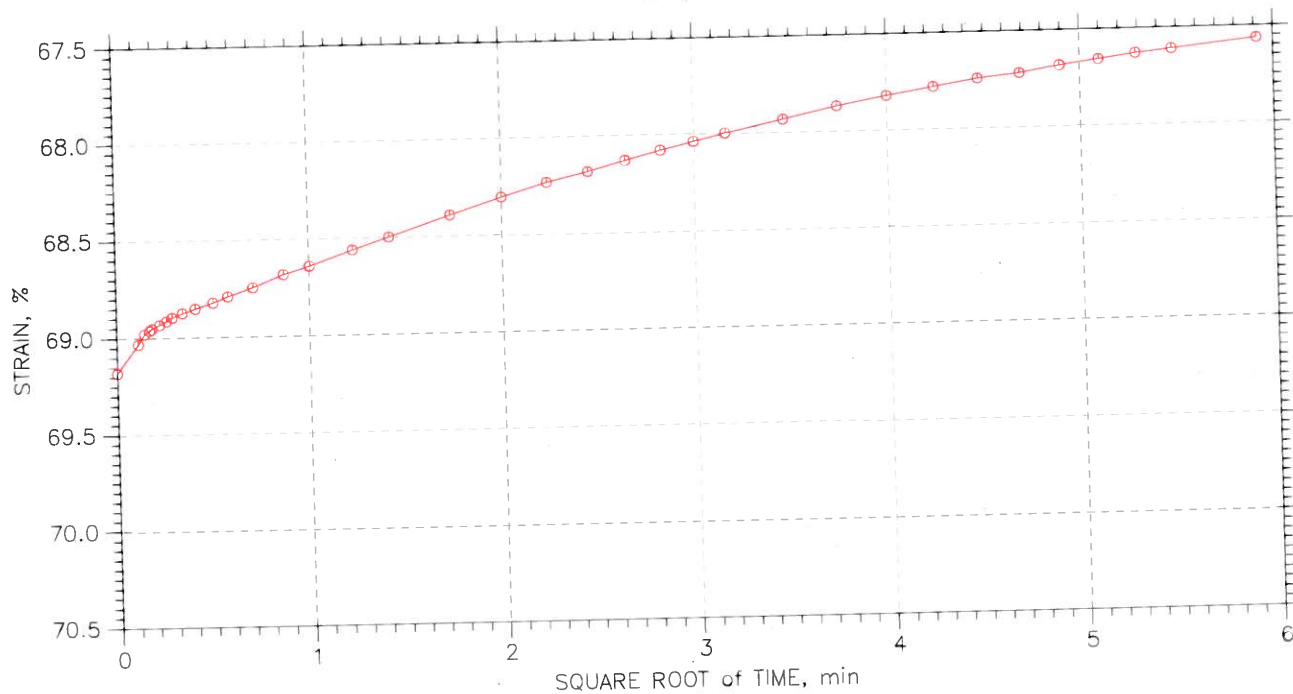
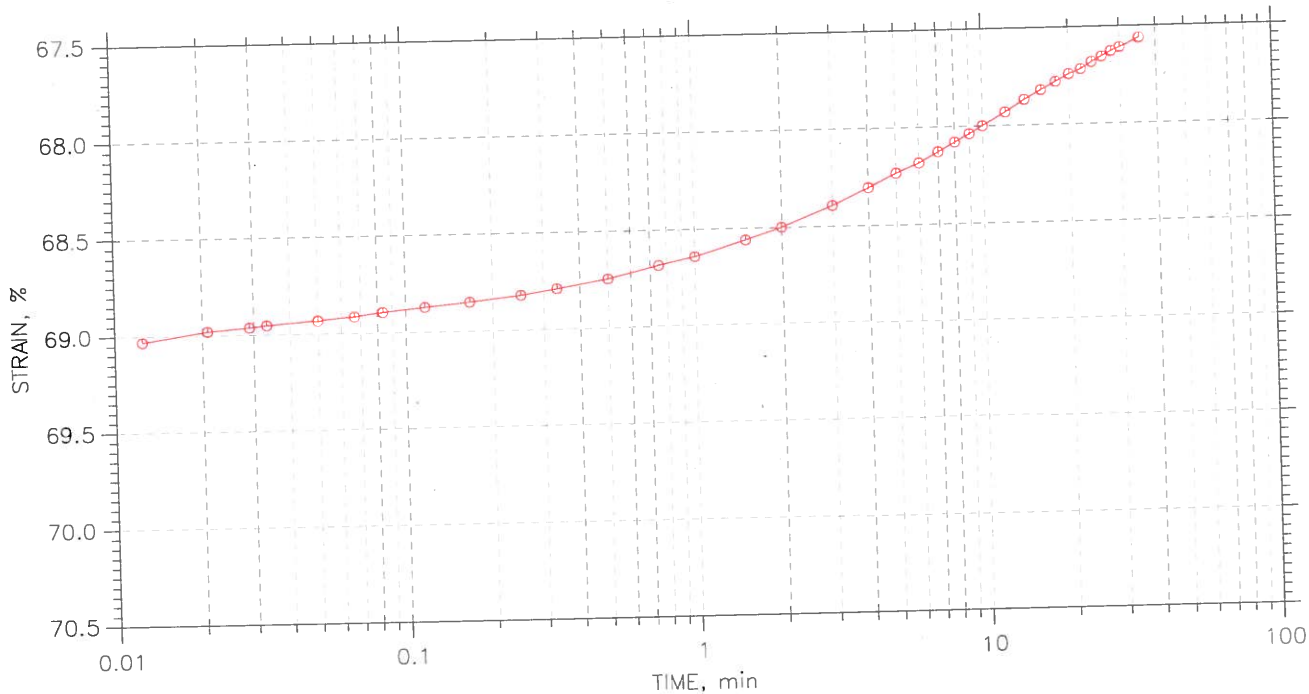
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-2	Test Date: 10-31-07	Depth: ---
	Test No.: 21681	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 8

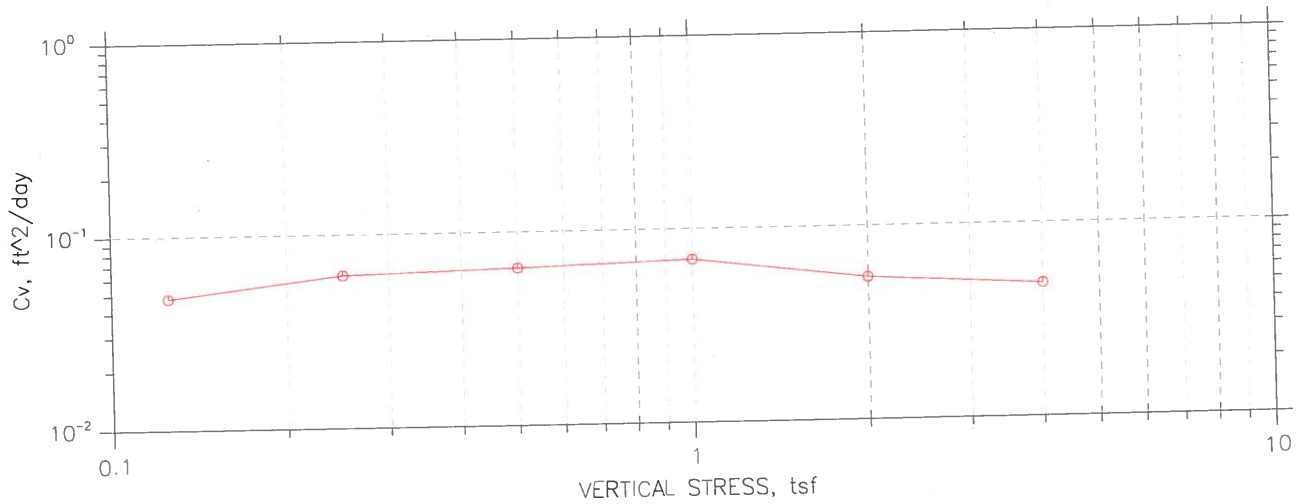
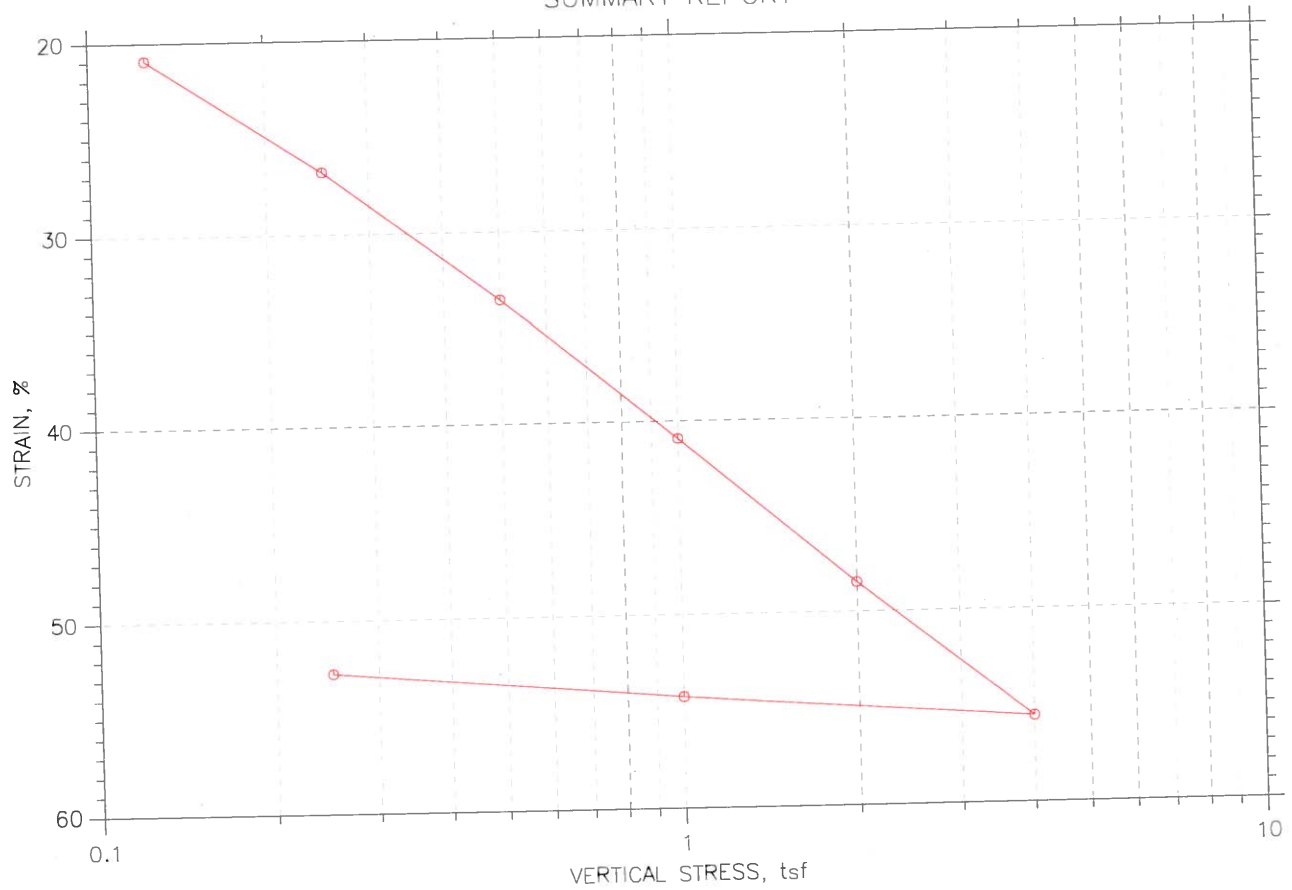
Stress: 0.25 tsf



GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-2	Test Date: 10-31-07	Depth: ---
	Test No.: 21681	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

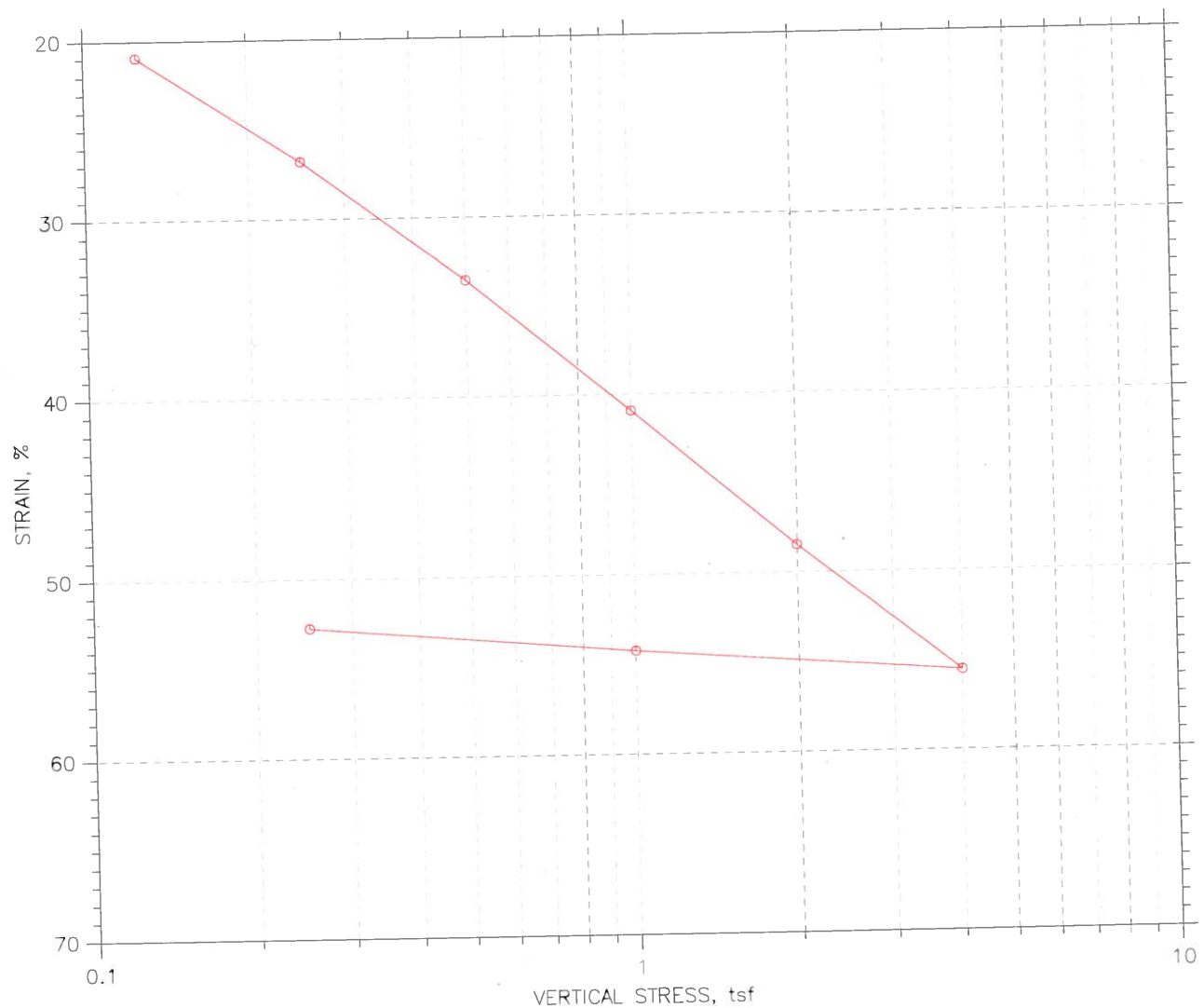
SUMMARY REPORT



GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

SUMMARY REPORT



				Before Test	After Test
Overburden Pressure: 0 tsf				352.62	125.27
Preconsolidation Pressure: 0 tsf				15.72	33.27
Compression Index: 0				98.34	83.97
Diameter: 2.5 in		Height: 1 in		9.32	3.88
LL: NP	PL: NP	PI: NP	GS: 2.60		

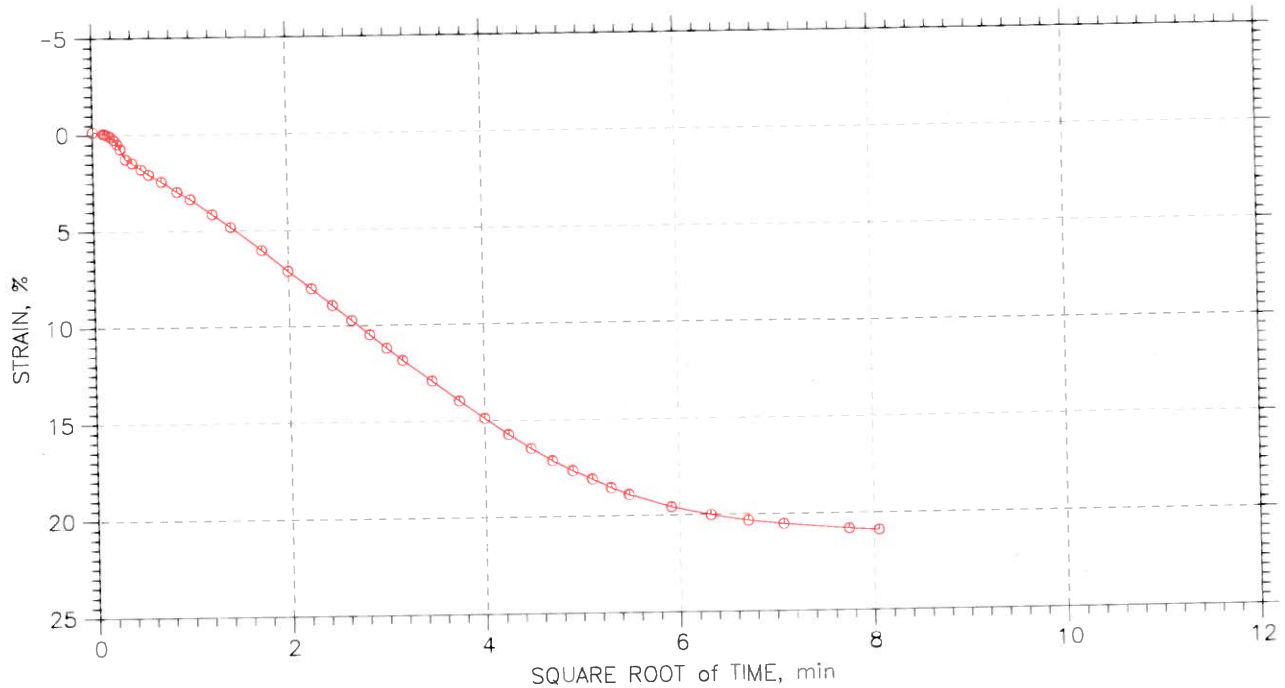
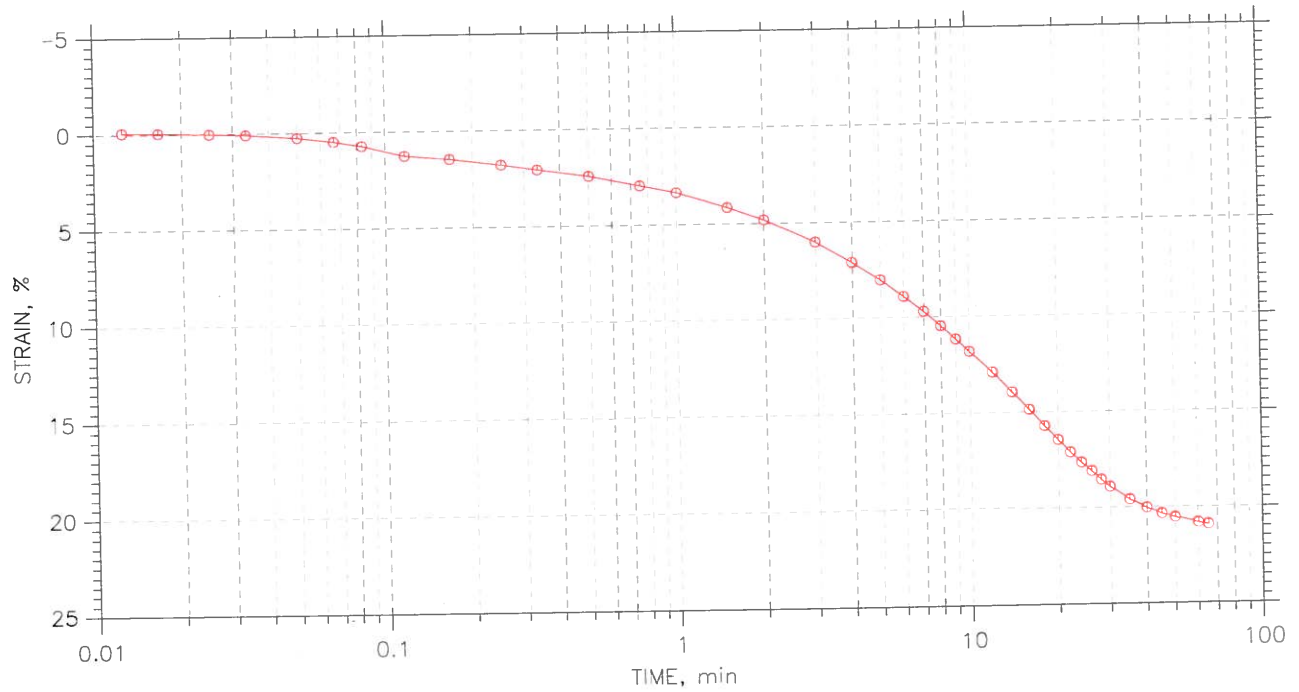
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 1 of 8

Stress: 0.125 tsf



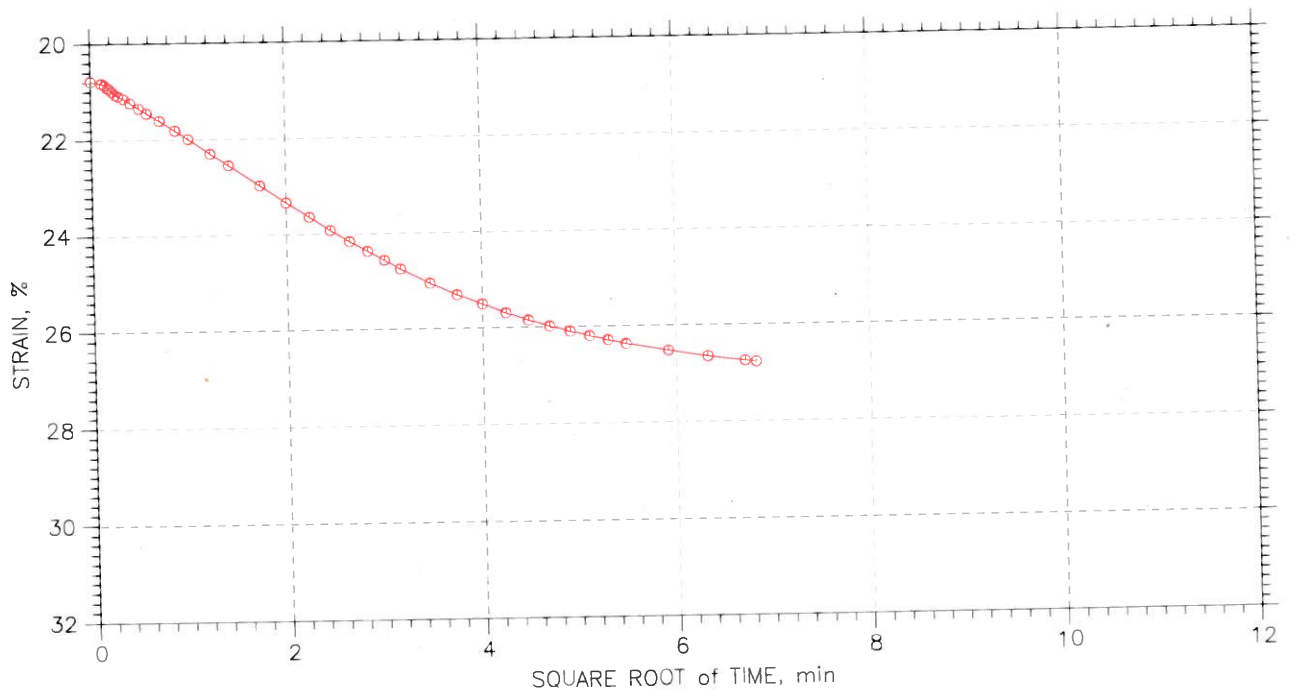
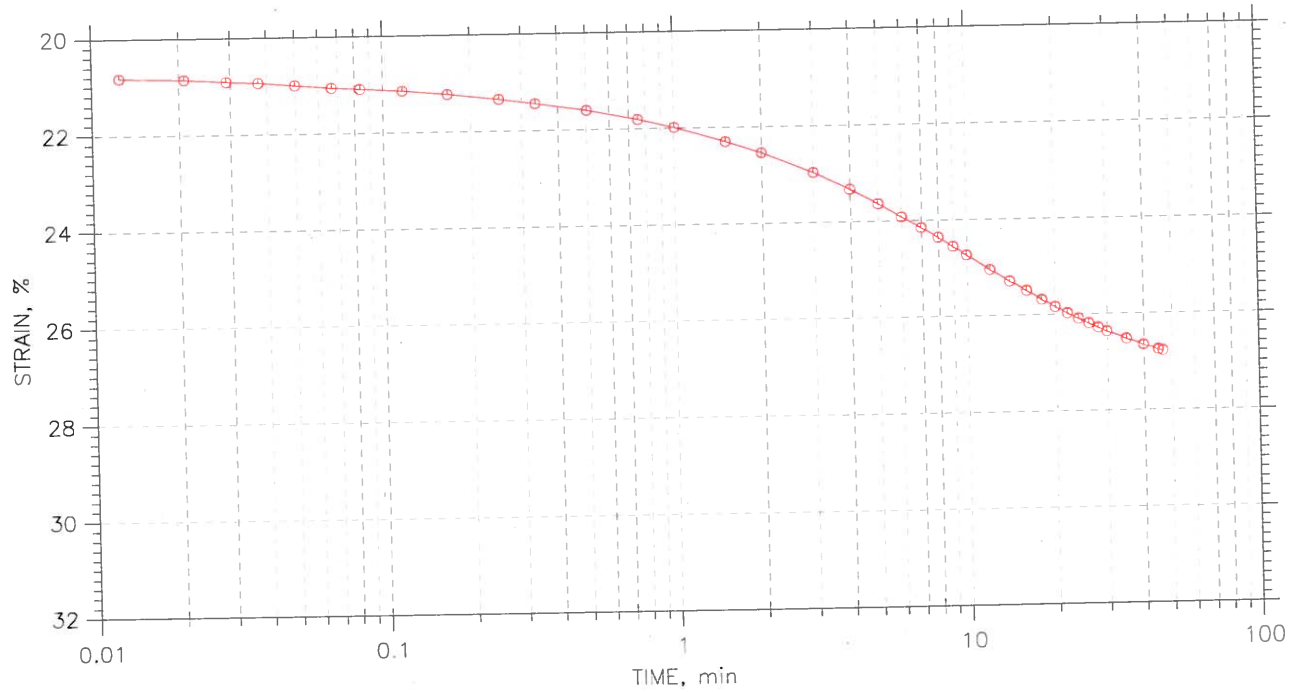
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 2 of 8

Stress: 0.25 tsf



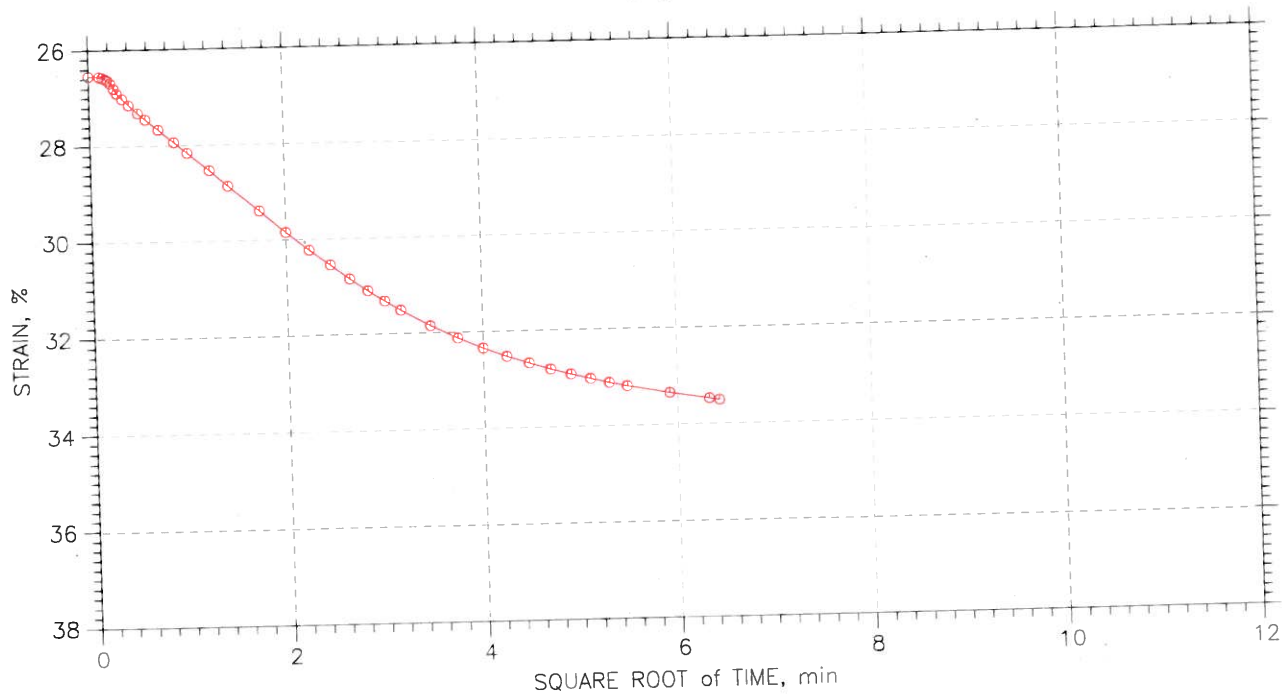
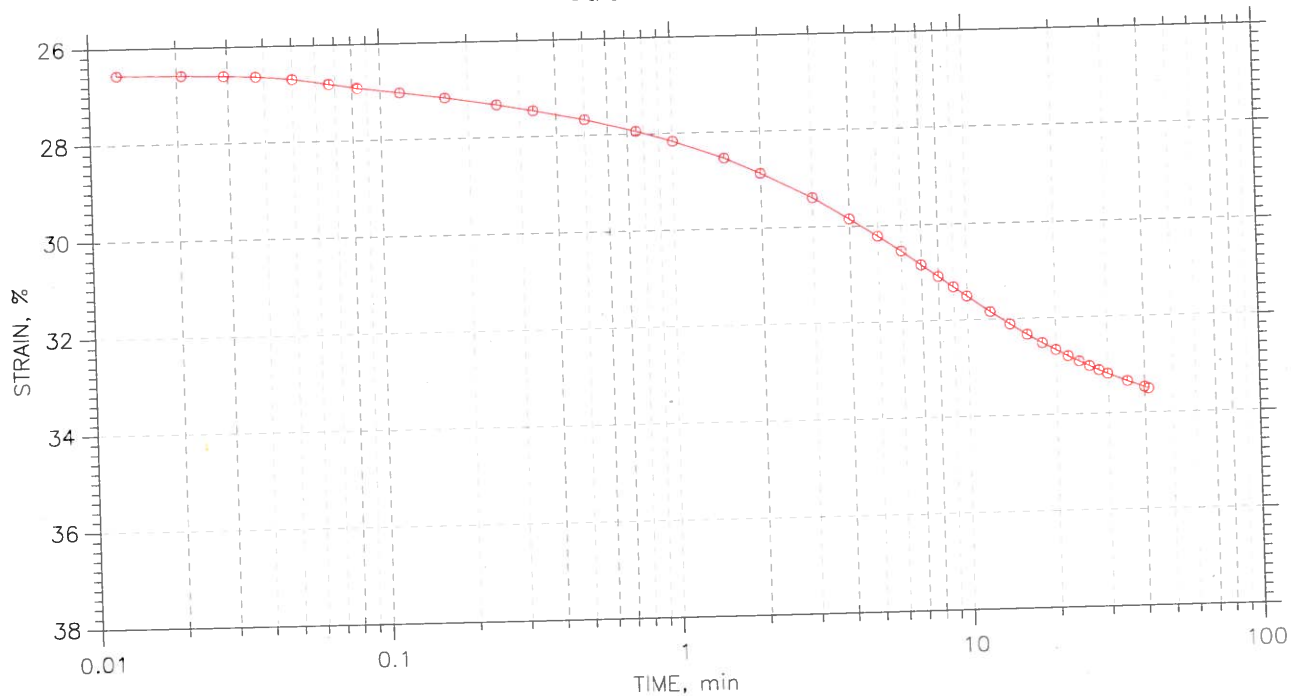
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 3 of 8

Stress: 0.5 tsf



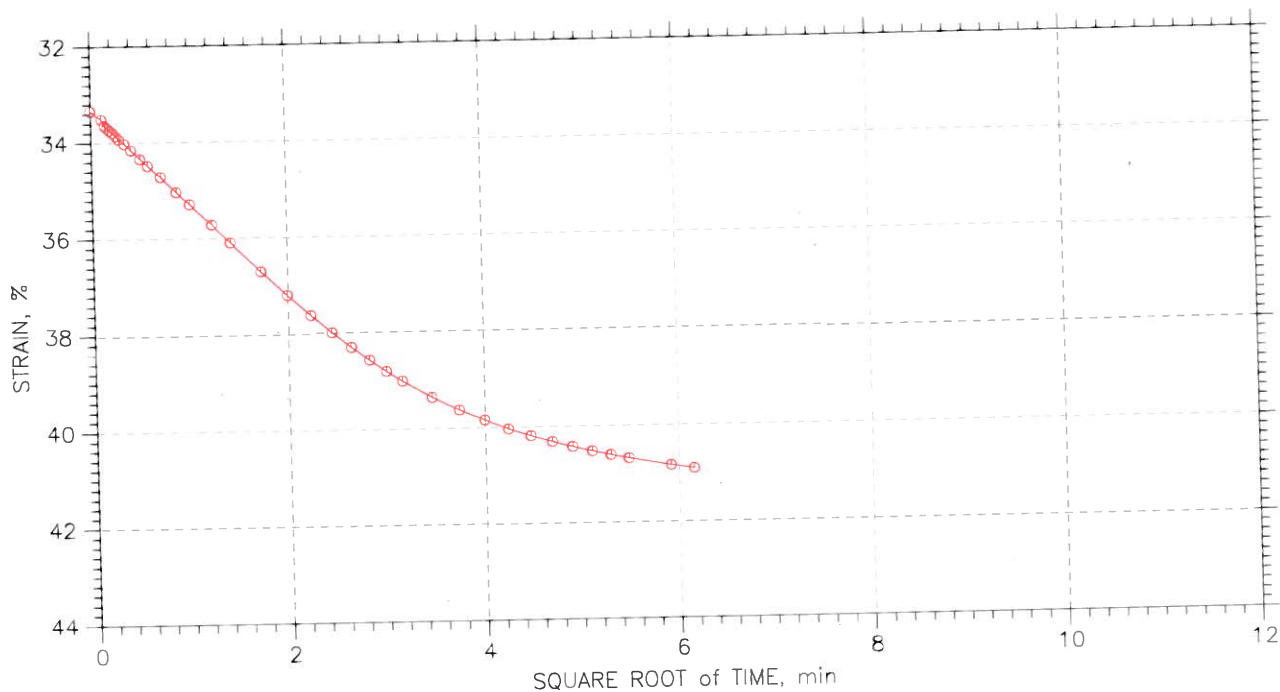
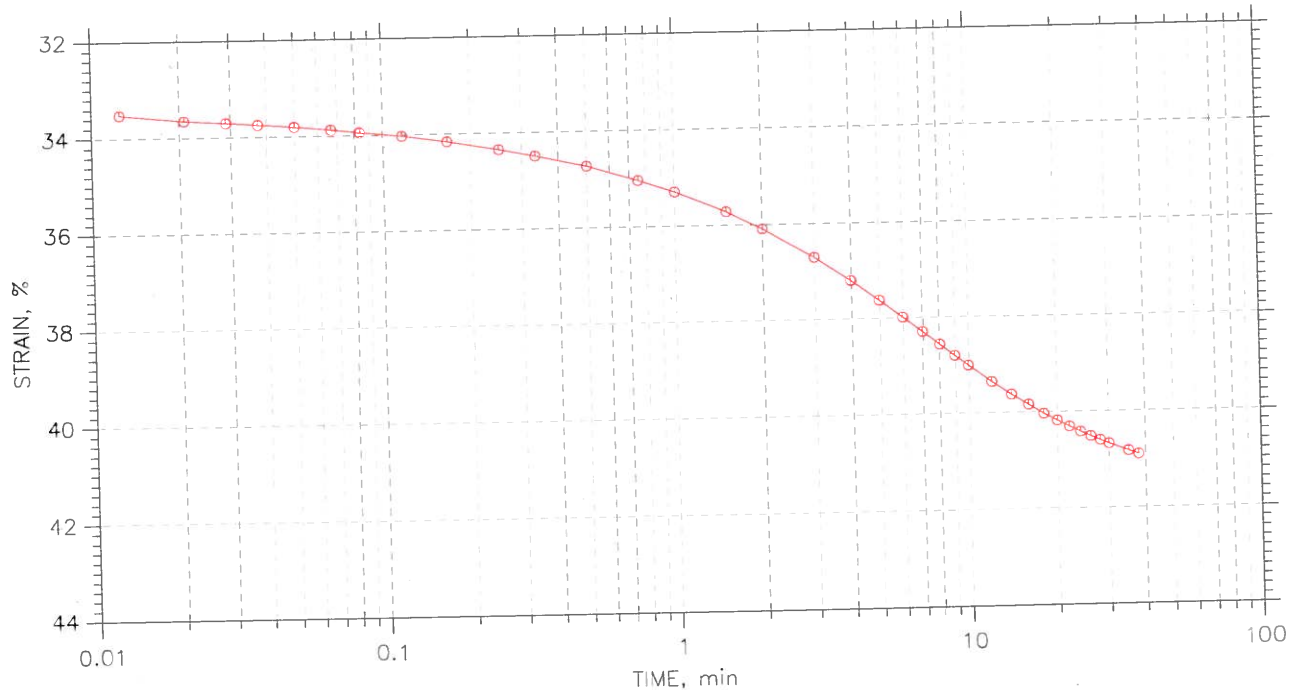
GeoTesting express the groundwork for success	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 4 of 8

Stress: 1. tsf



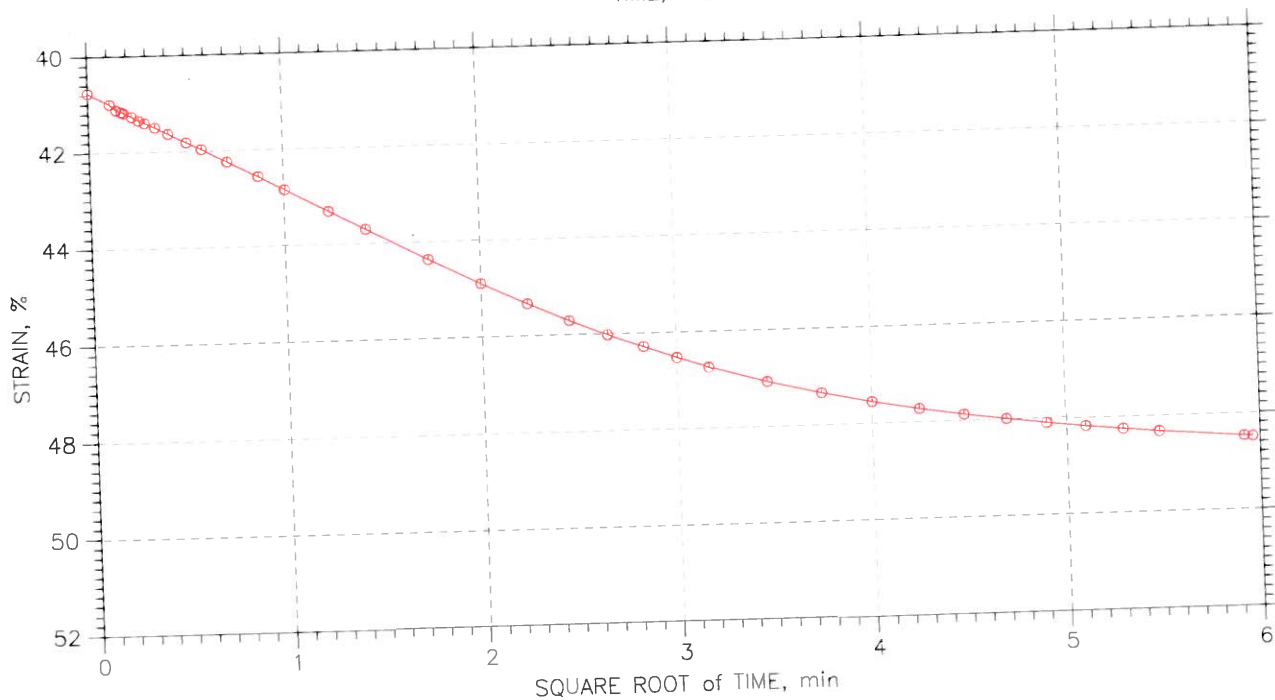
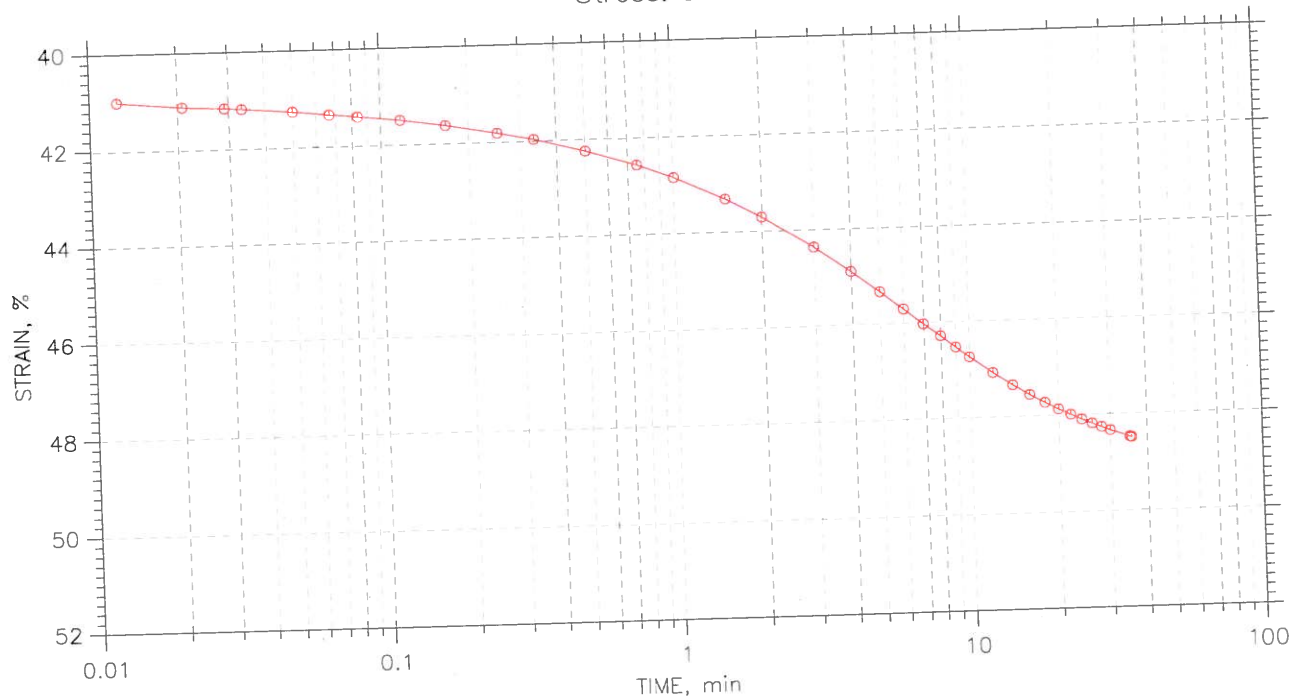
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 5 of 8

Stress: 2. tsf



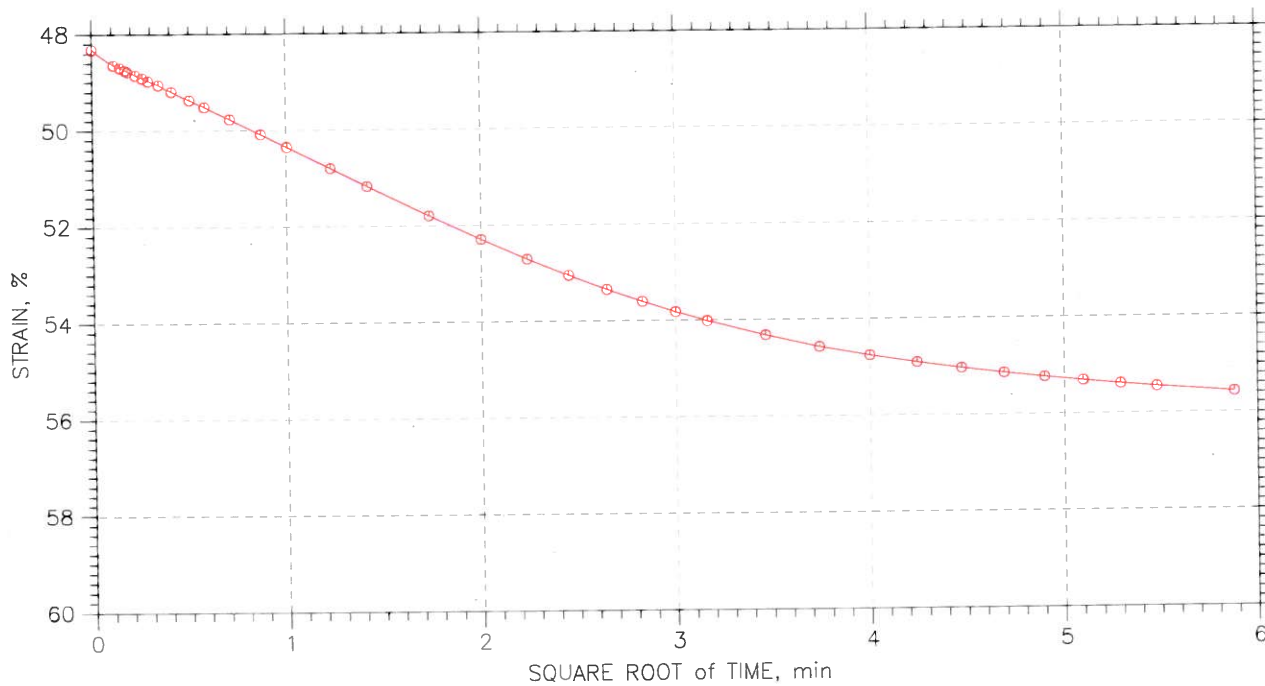
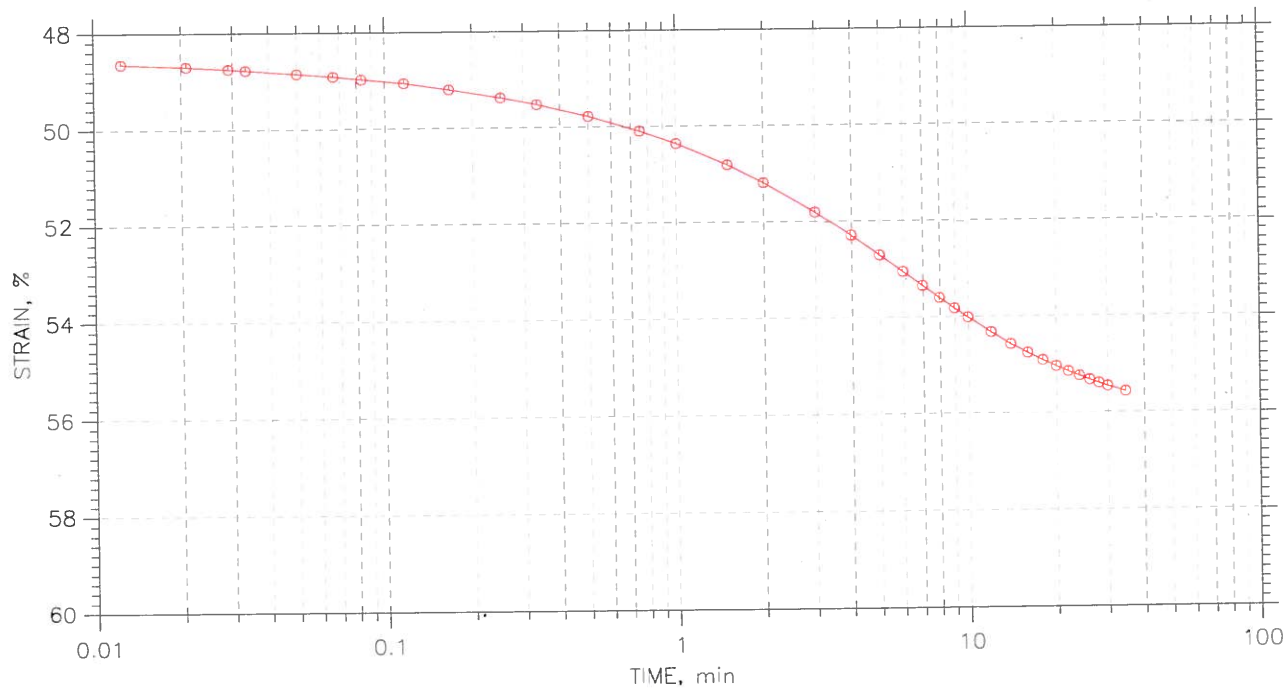
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 6 of 8

Stress: 4. tsf



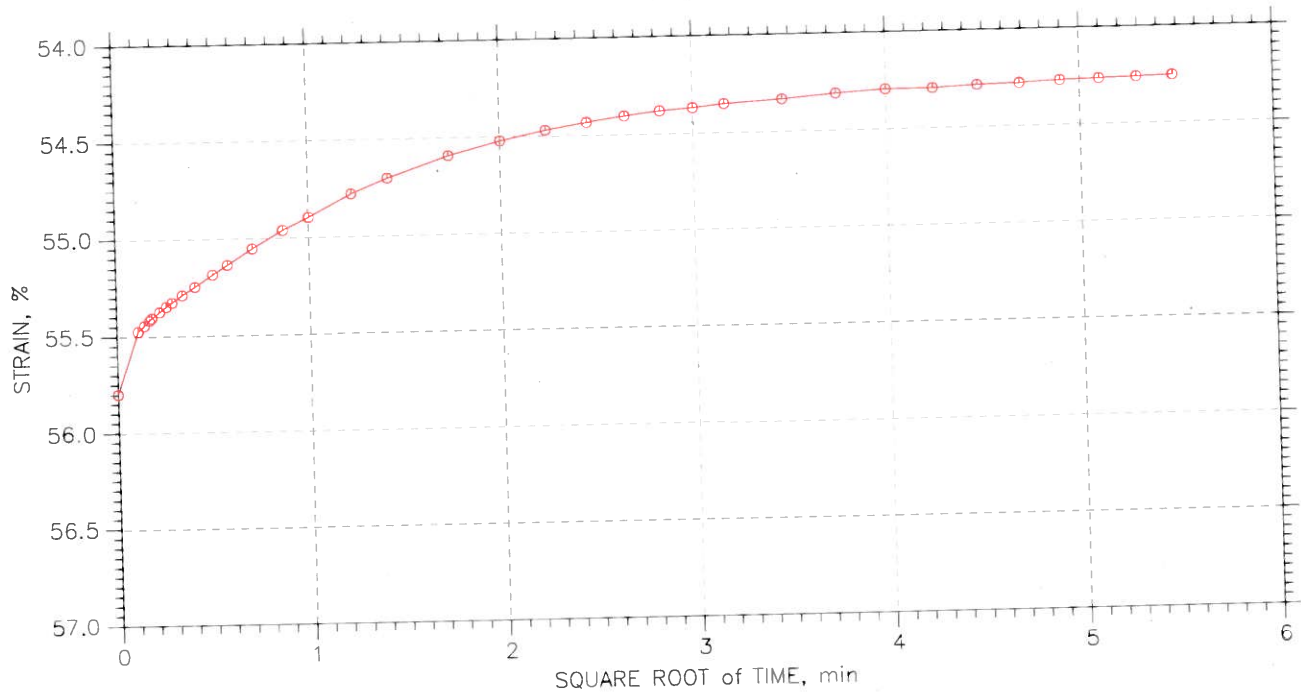
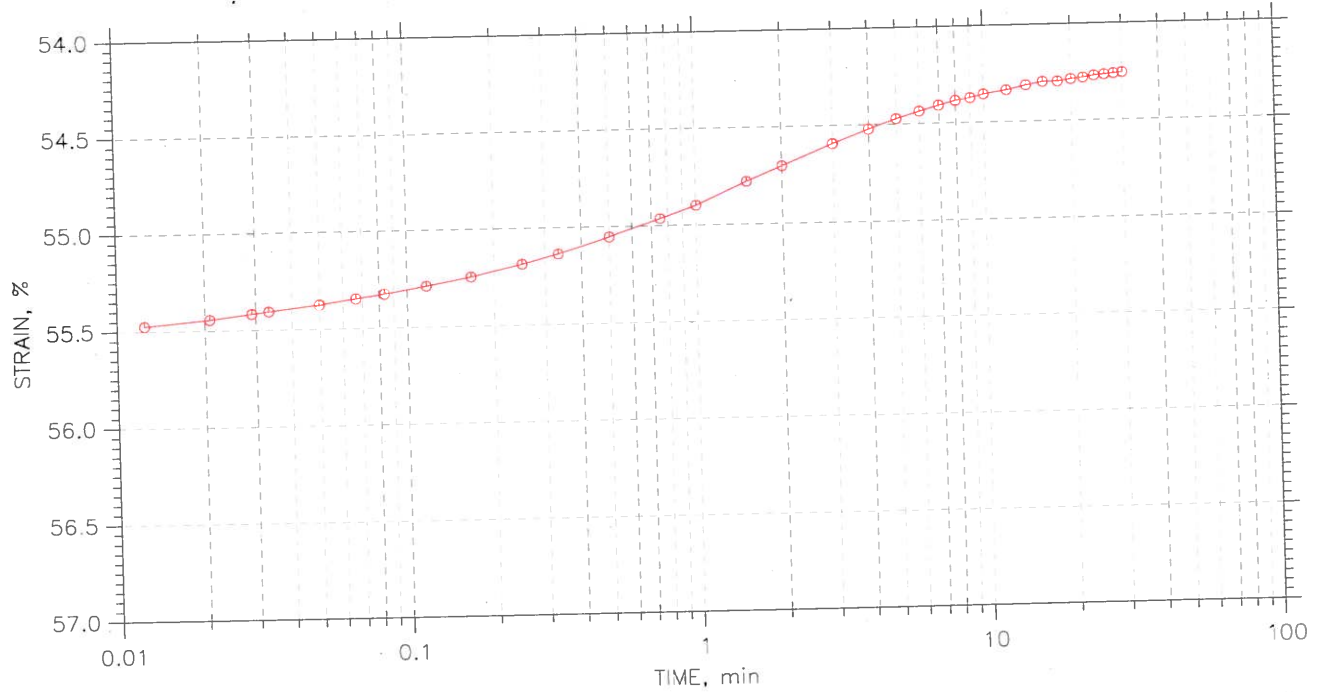
GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 7 of 8

Stress: 1. tsf



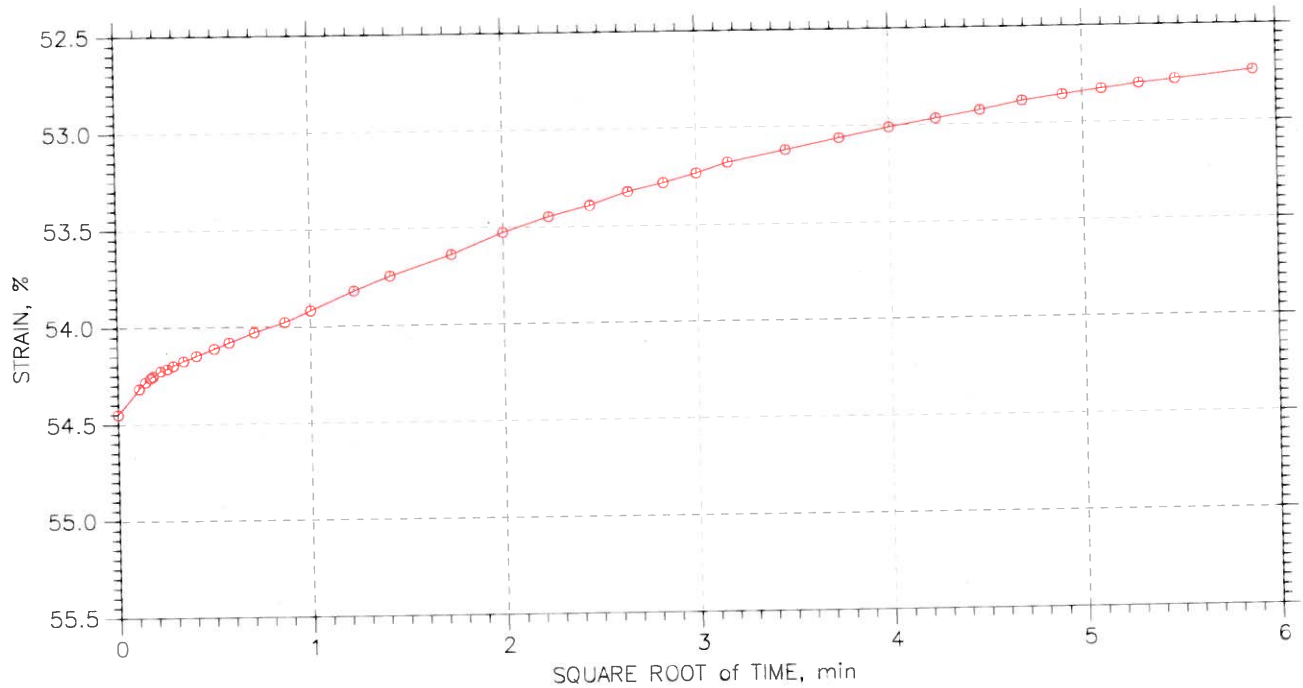
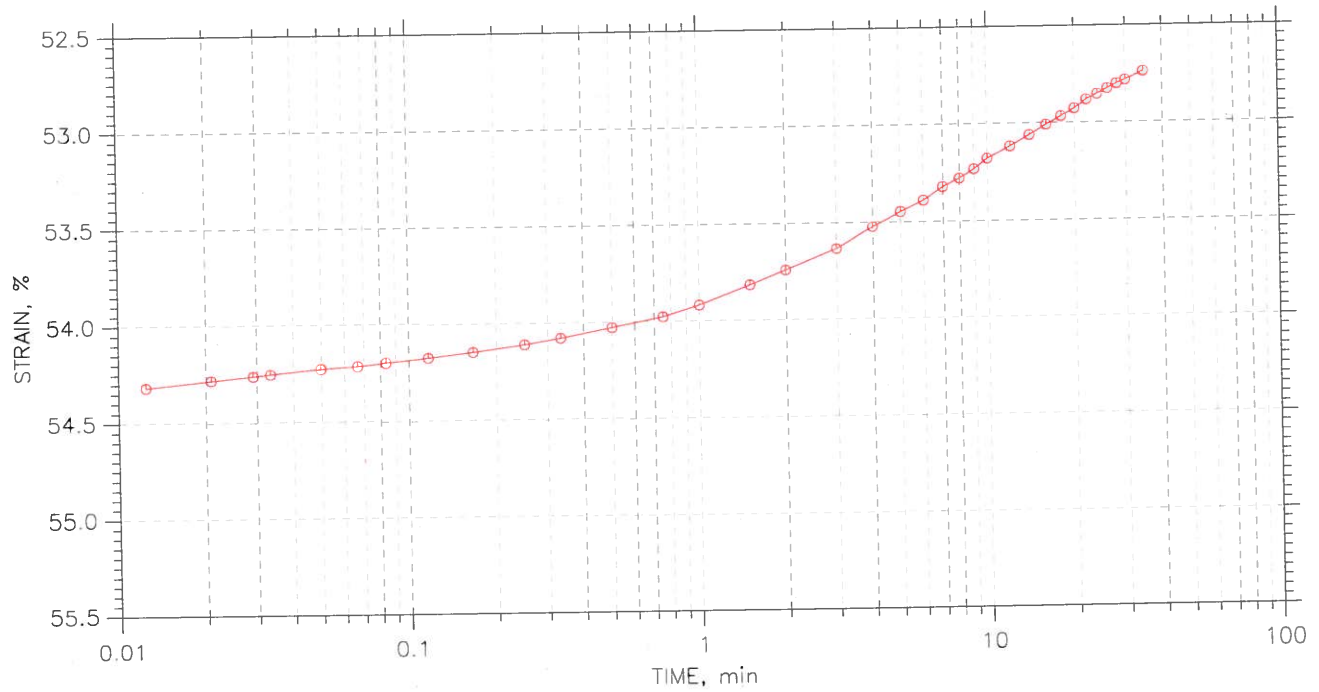
GeoTesting express <i>the groundwork for success</i>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

CONSOLIDATION TEST DATA

TIME CURVES

Constant Load Step: 8 of 8

Stress: 0.25 tsf



GeoTesting express <small>the groundwork for success</small>	Project: Lagoon Stabilization	Location: ---	Project No.: GTX-1304
	Boring No.: ---	Tested By: mm	Checked By: ca
	Sample No.: L-3	Test Date: 11-6-07	Depth: ---
	Test No.: 21682.1	Sample Type: Untreated	Elevation: ---
	Description: Stabilized Soil		
	Remarks: System 5077		

APPENDIX D

Financial Responsibility for Closure and Post Closure Care of Treatment Storage and Disposal Facilities

TEXTRON

Textron Inc.
40 Westminster St.
Providence, RI 02903

Tel: (401) 421-2800

2008 APR -2 A 11:56

RESTORATION & UNDERGROUND
STORAGE TANK BRANCH

March 31, 2008

VIA OVERNIGHT COURIER

Chief, Restoration and Underground Storage Tanks Branch
RCRA Division
U.S. Environmental Protection Agency
61 Forsyth Street, S.W.
Atlanta, GA 30303-3104 Executive Director

Re: Financial Responsibility Requirements for Closure
and Post Closure Care of Treatment Storage and Disposal Facilities

Dear Chief:

Textron Inc., located in Providence, Rhode Island, is the owner and operator of a facility located in Grenada, Mississippi which is subject to regulations applicable to owners and operators of Hazardous Waste Treatment, Storage and Disposal Facilities.

In compliance with MHWMR Part 265, as respects closure and post-closure inflation adjusted cost estimates and updated financial information, respectively, Textron encloses the following:

1. A letter dated March 31, 2008 from the Chief Financial Officer of Textron Inc., as specified in the aforementioned;
2. A copy of the 2007 Annual Report of Textron Inc. containing a report by Ernst & Young on Textron's financial statements for the fiscal year ended December 29, 2007; and
3. A letter from Ernst & Young that verifies the financial information contained in the letter referred to in Paragraph 1 above.

Please do not hesitate to call me should you have any questions or concerns with respect to any of the above. My direct line is (401) 457-6023.

Sincerely,



Maureen Flaherty
Environmental Health & Safety Accounting Analyst

DEQLTRS Enclosures

cc: Ernst & Young (w/enclosures)

c:\finrs08\randcov.doc



10532946

TEXTRON

Textron Inc.
40 Westminster St.
Providence, RI 02903

Tel: (401) 421-2800

2008 APR -2 A 11:56

RESTORATION & UNDERGROUND STORAGE TANK BRANCH

March 31, 2008

Chief, Restoration and Underground Storage Tanks Branch
RCRA Division
U.S. Environmental Protection Agency
61 Forsyth Street, S.W.
Atlanta, GA 30303-3104

**RE: Financial Assurance Requirements Demonstrating
Financial Responsibility for Liability Coverage and Closure Care**

Dear Chief;

I am the Chief Financial Officer of Textron Inc., 40 Westminster Street, Providence, Rhode Island 02903. This letter is in support of the use of the financial test to demonstrate financial responsibility for liability coverage and closure and/or post-closure care as specified in Subpart H of 40 CFR Parts 264 and 265.

The firm identified above is the owner or operator or is financially responsible for the following facilities for which liability coverage for both sudden and non-sudden accidental occurrences is being demonstrated through the financial test specified in Subpart H of 40 CFR Parts 264 and 265: **Textron Inc. (Randall - RCRA) 635 Highway #332, Grenada, MS 38901; EPA #MSD007037278**

The firm identified above guarantees, through the guarantee specified in Subpart H of 40 CFR Parts 264 and 265, liability coverage for both sudden and non-sudden accidental occurrences at the following facilities owned or operated by the following: **None**

1. The firm identified above owns or operates or is financially responsible for the following facilities which are in the State of Mississippi for which financial assurance for closure and/or post-closure care is demonstrated through the financial test specified in Subpart H of 40 CFR Parts 264 and 265. The current closure and/or post-closure cost estimates covered by the test are shown for each facility. **Textron Inc. (Randall - RCRA) 635 Highway #332, Grenada, MS 38901; EPA #MSD007037278. Closure \$6,386,270; Post-closure \$2,529,450**
2. The firm identified above guarantees, through the corporate guarantee specified in Subpart H of 40 CFR Parts 264 and 265, the closure and post-closure care or liability coverage of the following facilities owned or operated by the guaranteed party. The current cost estimates for the closure or post-closure care so guaranteed are shown for each facility: **None**
3. In states where EPA is not administering the financial requirements of Subpart H of 40 CFR Parts 264 and 265, this firm is demonstrating financial assurance for the closure or post-closure care of the following facilities through the use of a test equivalent or substantially equivalent to the financial test specified in Subpart H of 40 CFR Parts 264 and 265. The current closure and/or post-closure cost estimates covered by such a test or guarantee are shown for each facility: **See Exhibit A**

4. The firm identified above owns or operates the following hazardous waste management facilities for which financial assurance for closure, or if a disposal facility, for post-closure care, is not demonstrated either to EPA or a State through the financial test or any other financial assurance mechanism specified in Subpart H of 40 CFR Parts 264 and 265, or equivalent or substantially equivalent State mechanism. The current closure and/or post-closure cost estimates not covered by such financial assurance are shown for each facility: None
5. This firm is the owner or operator of the following UIC facilities for which financial assurance for plugging and abandonment is required under Part 144 and is assured through a financial test. The current closure cost estimates as required by 40 CFR 144.62 are shown for each facility: None

The firm is required to file a Form 10K with the Securities and Exchange Commission (SEC) for the latest fiscal year.

The fiscal year of this firm ends on the Saturday nearest to the thirty-first day of December in each year, whether such Saturday falls in December or in January. The figures for the following items marked with an asterisk are derived from this firm's independently audited, year-end financial statements for the latest completed fiscal year ended December 29, 2007.

ALTERNATIVE II

- | | |
|---|-----------------------|
| 1. Sum of current closure and post-closure estimates (total of all cost estimates listed above) | \$ 18,135,670 |
| 2. Amounts of annual aggregate liability coverage to be demonstrated | \$ 8,000,000 |
| 3. Sum of lines 1 and 2 | \$ 26,135,670 |
| 4. Current bond rating of most recent issuance and name of rating service | A-; Standard & Poor's |
| 5. Date of issuance of bond | November 29, 2007 |
| 6. Date of maturity of bond | December 1, 2017 |
| *7. Tangible net worth (if any portion of the closure or post-closure cost estimates is included in "total liabilities" on your financial statements you may add that portion to this line) | \$ 694,000,000 |
| *8. Total assets in the U.S. (required only if less than 90% of assets are located in the U.S.) | \$17,799,000,000 |
| 9. Is line 7 at least \$10 million? | Yes |
| 10. Is line 7 at least 6 times line 3? | Yes |
| *11. Are at least 90% of assets located in the U.S.? If not, complete line 12. | No |
| 12. Is line 8 at least 6 times line 3? | Yes |

I hereby certify that the wording of this letter is identical to the wording specified in 40 CFR Section 264.151(g), as such regulations were constituted on the date shown immediately below.


By: 
Name: Ted R. French
Title: Executive Vice President and Chief Financial Officer
Date: March 31, 2008

Exhibit A

	<u>Location</u>	<u>EPA#</u>	<u>Closure Costs</u>	<u>Post-closure Costs</u>
Former Deere/Gastonia Plant	Little Mountain Road Gastonia, NC 28052	NCD091249417	\$ --	\$4,184,839
Textron Realty Operations (formerly Textron Defense Systems)	2221 Niagara Falls Boulevard Wheatfield, NY 14304	NYD002106276	\$ --	\$1,673,827
Former Cessna Aircraft Facility, ARC Division	429 Rockaway Valley Rd. Boonton, NJ 07005	NJD002155448	\$ --	\$2,671,284
Textron Inc. (formerly Randall Grenada)	Grenada Highway #332 East Route 2 Grenada, MS 38901	MSD007037278	\$ --	\$690,000

Grenada Manufacturing Facility - Corrective Measure Cost Estimates for Financial Assurance Calculations	
Site-Wide Activities*	\$2,529,450
Sludge Lagoon Closure	\$651,900
Sheet Pile Barrier	\$1,190,700
PRB**	\$648,300
Improved NAPL Recovery	\$1,645,370
Multi-Phase High Vacuum Extraction	\$2,250,000
TOTAL***	\$8,915,720

*Comprises site-wide monitoring, including indoor air monitoring, surface water, groundwater, and sediment monitoring; implementation of deed restrictions and institutional controls; and fencing.

**Cost includes 10- and 20-year rejuvenation of PRB.

***All costs calculated based on 30 year present worth estimates using a 5% rate of interest.

Report of Independent Registered Public Accounting Firm

To the Board of Directors
Textron Inc.

We have audited, in accordance with the standards of the Public Company Accounting Oversight Board (United States), the Consolidated Balance Sheet of Textron Inc. as of December 29, 2007 and December 30, 2006, and the related Consolidated Statements of Operations, Shareholders' Equity, and Cash Flows for each of the three years in the period ended December 29, 2007, and have issued our unqualified opinion thereon dated February 13, 2008, except for, as discussed in Note 5 to the Consolidated Financial Statements, in 2007 Textron Inc. adopted Financial Accounting Standard Board ("FASB") Staff Position No. 13-2, "Accounting for a Change or Projected Change in the Timing of Cash Flows Relating to Income Taxes Generated by a Leverage Lease Transaction," as discussed in Note 13 to the Consolidated Financial Statements, in 2007 Textron Inc. adopted FASB Interpretation No. 48, "Accounting for Uncertainty in Income Taxes an Interpretation of FASB Statement No. 109," and as discussed in Note 1 to the Consolidated Financial Statements, in 2006 Textron Inc. adopted Statement of Financial Accounting Standards No. 158, "Employers' Accounting for Defined Benefit Pension and Other Postretirement Plans - An amendment of FASB Statement Nos. 87, 88, 106, and 132(R)."

Mr. Ted R. French's letter dated March 31, 2008, in support of the use of the financial test, as specified in Subpart H of 40 CFR Parts 264 and 265, to demonstrate financial responsibility for liability coverage and closure and/or post-closure care of the Company's hazardous waste facilities, for the locations listed in the letter, is addressed to the Chief, Restoration and Underground Storage Tanks Branch, RCRA Division, of the U.S. Environmental Protection Agency.

In connection with our audit and in accordance with Subpart H of 40 CFR Parts 264 and 265, we compared the dollar amounts in the section entitled "Alternative II", line items 7, and 8, of the March 31, 2008 letter mentioned above, to the amounts in the audited consolidated financial statements described in the introductory paragraph of this letter included in the Company's annual report to shareholders for the fiscal year ended December 29, 2007, to the extent such amounts are included in or can be derived from such statements and found them to be in agreement.

This report is intended solely for your information and use, and for the use of the Chief, RCRA Programs Branch, Waste Management Division, of the U.S. Environmental Protection Agency, Region 4, and is not intended to be and should not be used by anyone other than these specified parties.

Ernst & Young LLP

March 31, 2008

APPENDIX E

Declarations of Land Use Restrictions

DECLARATION OF USE RESTRICTIONS

WHEREAS, Grenada County is the record owner ("Owner") of certain real property situated in the City of Grenada, County of Grenada, State of Mississippi and legally described on Exhibit A attached hereto and incorporated herein by reference and the improvements thereto (the "Property");

WHEREAS, Owner hereby desires to establish and impose certain covenants and restrictions on the Property for the purpose of supporting ongoing environmental activities being completed under the oversight and control of the United States Environmental Protection Agency ("U.S. EPA") and the Mississippi Department of Environmental Quality ("MDEQ"); and

WHEREAS, by imposing the covenants and restrictions to the Property described more fully below, Owner intends and desires to insure that the Property can continue to be used lawfully and safely in the future for commercial and/or industrial purposes;

NOW, THEREFORE, Owner, for itself and its successors and assigns in ownership of the Property, including, without limitation, lessees, does hereby declare the Property subject to the following perpetual restrictions, covenants and stipulations, to-wit:

1. No person shall install any groundwater wells or extract the groundwater in the uppermost aquifer located at or underlying the Property for any purpose, potable or non-potable, except for groundwater sampling, groundwater investigation, or remedial activities, as warranted and approved by the U.S. EPA and/or MDEQ.
2. The Property is hereby restricted to non-residential use only, and shall not be used as a hospital, school, day care facility, or other child-occupied facility, as those terms may be currently defined, or defined in the future, by zoning ordinance(s) of the City of Grenada or any other local governmental entity with jurisdiction and authority to regulate the land use at the Property.
3. There shall be no surface or subsurface demolition, excavation, drilling or other similar activities in the former chrome plating line area of the Property identified on Exhibit B without the prior written approval of the U.S. EPA and MDEQ.
4. Owner hereby grants access to the Property at all reasonable times to the U.S. EPA, the MDEQ, and any private persons (including their contractors, subcontractors and agents) who have not otherwise been granted access to the Property and who are authorized by the U.S. EPA and/or the MDEQ to undertake environmental activities on the Property relating in any way to the State of Mississippi Hazardous Waste Management Permit No. HW-007-037-278 or U.S. EPA RCRA Permit No. MSD 007 037 278. All parties obtaining or granted access to the Property under this provision shall conduct their activities on the Property in a manner which minimizes to the fullest extent possible any disruptions to the use and enjoyment of the Property by Owner, its

successors or assigns, and/or any other persons having an ownership or property interest in the Property.

5. This Declaration of Use Restrictions is intended to benefit and protect current and future owners and lessees of the Property (as well as any and all successors and assigns of the Property), adjoining property owners, citizens of the City and County of Grenada, and citizens of the State of Mississippi. Compliance with the Declaration of Use Restrictions contained herein may be enforced by a legal or equitable action brought in a court of competent jurisdiction by or on behalf of one or more of the following parties: (i) the U.S. EPA or its representative, (ii) the MDEQ or its representative; or (iii) any local governmental entity with the jurisdiction and legal authority to regulate land use at the Property. Delay or failure on the part of any of the foregoing parties to take any action to enforce compliance with the Declaration of Use Restrictions shall not bar any subsequent enforcement with respect to the failure of compliance in question, nor shall any delay or failure on the part of any of the foregoing parties to take any action to enforce compliance with the Declaration of Use Restrictions be deemed a waiver of the right of any such party to take any such action with respect to any failure of compliance.

6. Owner hereby reserves unto itself, its successors and assigns, and/or any other persons having an ownership or property interest in the Property all rights and privileges in and to the use of the Property which are not incompatible with the restrictions, rights, and covenants granted herein or otherwise previously granted.

7. This Declaration of Use Restrictions shall run with the land and be binding upon all current owners and lessees of the Property, and all successors and assigns of the Property, or any portion of the Property, including any leasehold interests on the Property or any portion of the Property unless and until the restrictions set forth herein are amended in writing by Owner, its successors or assigns, and approved in writing by the U.S. EPA and MDEQ.

8. This Declaration of Use Restriction shall be recorded in the same manner as a deed in the Office of the Chancery Clerk of Grenada, Mississippi, and shall be deemed incorporated by reference in any instrument hereafter conveying any interest in the Property, including, without limitation, any leases or easements.

9. If any one or more provisions of the Declaration of Use Restrictions herein contained shall be found to be unenforceable in any respect, the validity, legality and enforceability of the remaining provisions shall not in any way be affected or impaired thereby. This Declaration of Use Restrictions shall be governed by and interpreted in accordance with the laws of the State of Mississippi.

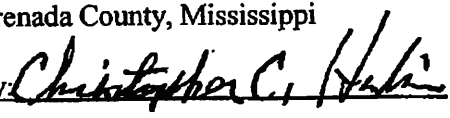
10. Any instrument hereafter conveying any interest in the Property or any portion thereof shall contain a recital acknowledging this Declaration and providing the recording location of this Declaration.

IN WITNESS WHEREOF , Grenada County, Mississippi, has executed this

Declaration of Use Restrictions as of the 30th day of March, 2005.

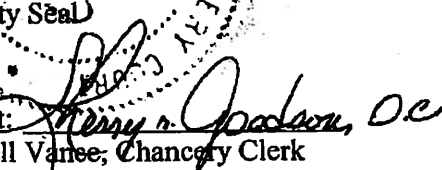
Grenada County, Mississippi

By:


Christopher C. Hankins,
President, Grenada County
Board of Supervisors



Attest:


Powell Vance, Chancery Clerk
Grenada County, Mississippi

Prepared by:

Gore, Kilpatrick, Purdie, Metz & Adcock, PLLC
P. O. Box 901
Grenada, MS 38902-0901
662-226-1891

Indexing Instructions:

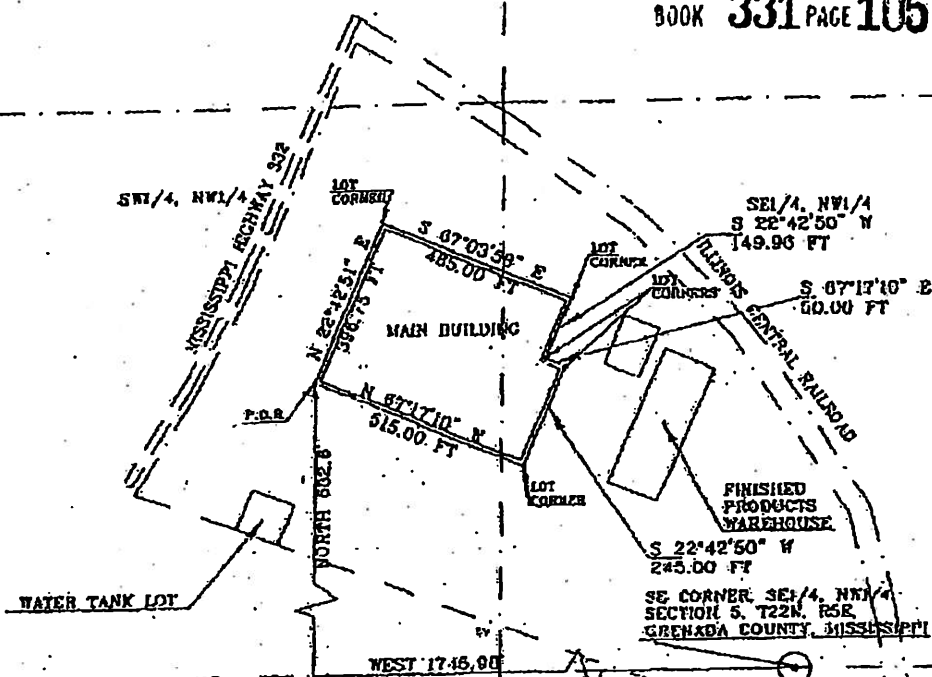
Part of the SW Quarter of the NW Quarter, and part of the SE Quarter of the NW Quarter, all in Section 5, T22N, R5 E, Grenada County, Mississippi, containing 4.5 acres, more or less.

219038 JAN-98

NW1/4, NW1/4

EXHIBIT "A"

BOOK 331 PAGE 105



DESCRIPTION:

Part of the SW quarter of the NW quarter, and part of the SE quarter of the NW quarter, all in Section 5, T22N, R5E, City of Grenada, Grenada County, Mississippi, more particularly described as follows:
Beginning at a point 1745.00 FT west and 602.60 FT north of the SE corner of the SE quarter of the NW quarter of said Section 5; proceed thence N 22°42'51" E a distance of 396.75 FT to a point; thence S 67°03'58" E a distance of 485.00 FT to a point; thence S 22°42'50" W a distance of 149.96 FT to a point; thence S 67°17'10" E a distance of 50.00 FT to a point; thence S 22°42'50" W a distance of 245.00 FT to a point; thence N 67°17'10" W a distance of 515.00 FT to the point of beginning, containing 4.5 acres, more or less.

JOE A. SUTHERLAND, JR. P.E.-L.S.

SURVEY PLAT

ENGINEER-SURVEYOR
P.O. BOX 311 S. GREEN ST.
GRENADE, MISS. 38902-0311 TEL (601)724-3503

CLIENT RANDALL TEXTRON PROPERTY DIVISION

DRAWN BY JAS

CHECKED BY JAS

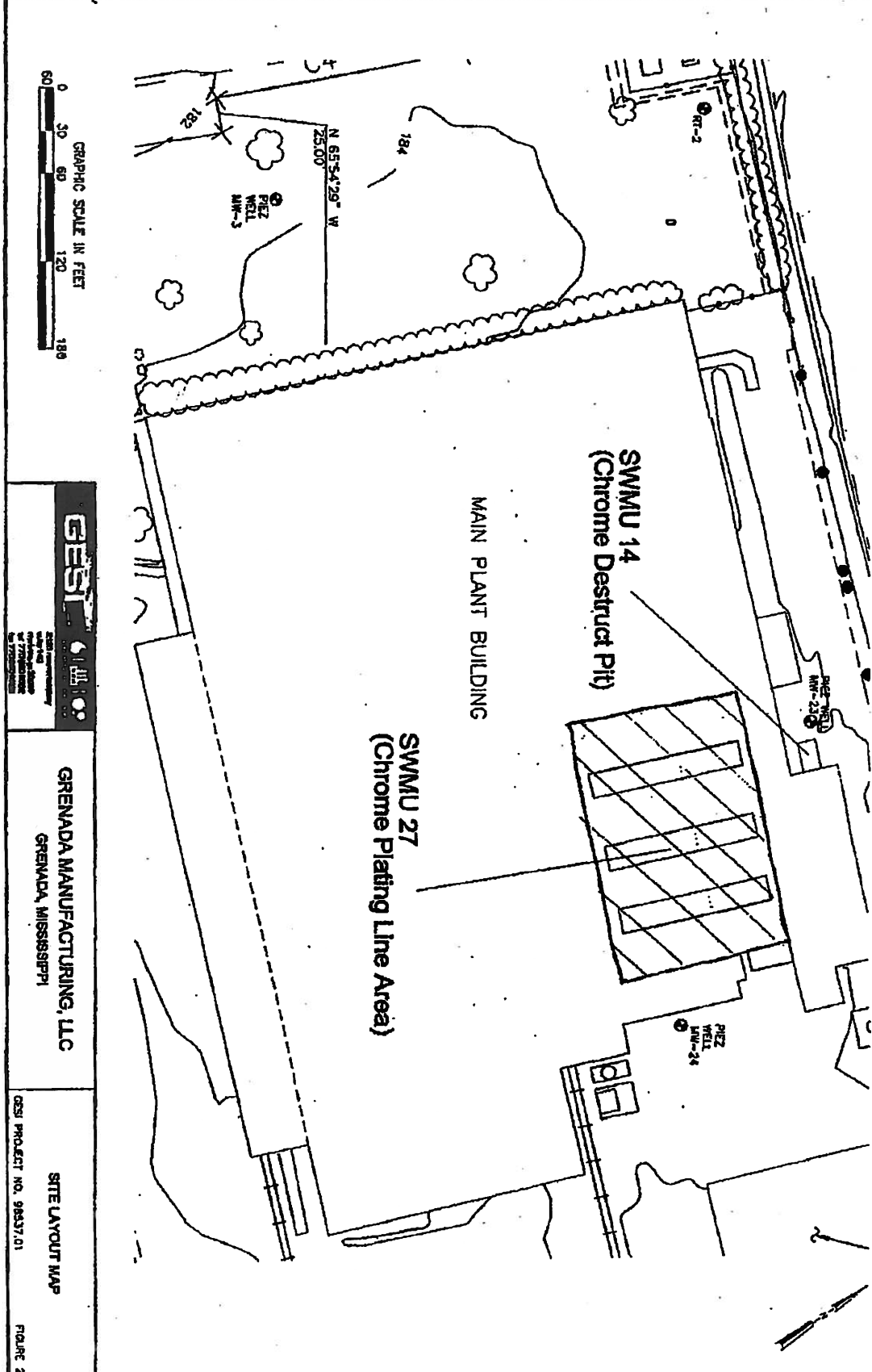
DATE 5-8-99

RANDYWHILEL

RANDY.DWG

EXHIBIT "B"

FILE: P:\VENTRON\GRENADA\CLOSURES\PLATING LINE CLOSURE\CLOS_REPORT\FIGURES2_3_4.DWG PLOT DATE: 01/23/2004



<p>GESI Geospatial Engineering & Surveying, Inc. 1000 Highway 100 Suite 100 Grenada, Mississippi 38901 Phone: 662-933-7011 Fax: 662-933-7012</p>	<p>GRENADA MANUFACTURING, LLC GRENADA, MISSISSIPPI</p>	<p>SITE LAYOUT MAP FIGURE 2</p>
	<p>GESI PROJECT NO. 98337.01</p>	

STATE OF MISSISSIPPI
COUNTY OF GRENADA

PERSONALLY appeared before me, the undersigned authority in and for the jurisdiction aforesaid on this the 30th day of March, 2005, the within named C. Columbus Hankins who acknowledged that he is the President of the Board of Supervisors and Powell Vance, and that for and on behalf of Grenada County, as its act and deed, they have executed the above and foregoing instrument, after first having been duly authorized by said county so to do.



Sandra Gail Edwards
Notary Public

BOOK 332 PAGE 165

STATE OF MISSISSIPPI
GRENADA COUNTY

CHANCERY CLERK'S
OFFICE

I hereby certify that the within instrument was filed for record
in my office on the 31st day of May, 2005
at 3:30 o'clock P.M. and recorded this 31st day
of May, 2005, in Book 332 Page 165
POWELL VANCE, Chancery Clerk 6/1/05
D.C.

DECLARATION OF USE RESTRICTIONS

H/M. Brown

WHEREAS, City of Grenada is the record owner ("Owner") of certain real property situated in the City of Grenada, County of Grenada, State of Mississippi and legally described on Exhibit A attached hereto and incorporated herein by reference and the improvements thereto (the "Property");

WHEREAS, Owner hereby desires to establish and impose certain covenants and restrictions on the Property for the purpose of supporting ongoing environmental activities being completed under the oversight and control of the United States Environmental Protection Agency ("U.S. EPA") and the Mississippi Department of Environmental Quality ("MDEQ"); and

WHEREAS, by imposing the covenants and restrictions to the Property described more fully below, Owner intends and desires to insure that the Property can continue to be used lawfully and safely in the future for commercial and/or industrial purposes;

NOW, THEREFORE, Owner, for itself and its successors and assigns in ownership of the Property, including, without limitation, lessees, does hereby declare the Property subject to the following perpetual restrictions, covenants and stipulations, to-wit:

1. No person shall install any groundwater wells or extract the groundwater in the uppermost aquifer located at or underlying the Property for any purpose, potable or non-potable, except for groundwater sampling, groundwater investigation, or remedial activities, as warranted and approved by the U.S. EPA and/or MDEQ.
2. The Property is hereby restricted to non-residential use only, and shall not be used as a hospital, school, day care facility, or other child-occupied facility, as those terms may be currently defined, or defined in the future, by zoning ordinance(s) of the City of Grenada or any other local governmental entity with jurisdiction and authority to regulate the land use at the Property.
3. There shall be no surface or subsurface demolition, excavation, drilling or other similar activities in the former chrome plating line area of the Property identified on Exhibit B without the prior written approval of the U.S. EPA and MDEQ.
4. Owner hereby grants access to the Property at all reasonable times to the U.S. EPA, the MDEQ, and any private persons (including their contractors, subcontractors and agents) who have not otherwise been granted access to the Property and who are authorized by the U.S. EPA and/or the MDEQ to undertake environmental

activities on the Property relating in any way to the State of Mississippi Hazardous Waste Management Permit No. HW-007-037-278 or U.S. EPA RCRA Permit No. MSD 007 037 278. All parties obtaining or granted access to the Property under this provision shall conduct their activities on the Property in a manner which minimizes to the fullest extent possible any disruptions to the use and enjoyment of the Property by Owner, its successors or assigns, and/or any other persons having an ownership or property interest in the Property.

5. This Declaration of Use Restrictions is intended to benefit and protect current and future owners and lessees of the Property (as well as any and all successors and assigns of the Property), adjoining property owners, citizens of the City and County of Grenada, and citizens of the State of Mississippi. Compliance with the Declaration of Use Restrictions contained herein may be enforced by a legal or equitable action brought in a court of competent jurisdiction by or on behalf of one or more of the following parties: (i) the U.S. EPA or its representative, (ii) the MDEQ or its representative; or (iii) any local governmental entity with the jurisdiction and legal authority to regulate land use at the Property. Delay or failure on the part of any of the foregoing parties to take any action to enforce compliance with the Declaration of Use Restrictions shall not bar any subsequent enforcement with respect to the failure of compliance in question, nor shall any delay or failure on the part of any of the foregoing parties to take any action to enforce compliance with the Declaration of Use Restrictions be deemed a waiver of the right of any such party to take any such action with respect to any failure of compliance.

6. Owner hereby reserves unto itself, its successors and assigns, and/or any other persons having an ownership or property interest in the Property all rights and privileges in and to the use of the Property which are not incompatible with the restrictions, rights, and covenants granted herein or otherwise previously granted.

7. This Declaration of Use Restrictions shall run with the land and be binding upon all current owners and lessees of the Property, and all successors and assigns of the Property, or any portion of the Property, including any leasehold interests on the Property or any portion of the Property unless and until the restrictions set forth herein are amended in writing by Owner, its successors or assigns, and approved in writing by the U.S. EPA and MDEQ.

8. This Declaration of Use Restriction shall be recorded in the same manner as a deed in the Office of the Chancery Clerk of Grenada, Mississippi, and shall be deemed incorporated by reference in any instrument hereafter conveying any interest in the Property, including, without limitation, any leases or easements.

9. If any one or more provisions of the Declaration of Use Restrictions herein contained shall be found to be unenforceable in any respect, the validity, legality and enforceability of the remaining provisions shall not in any way be affected or impaired thereby. This Declaration of Use Restrictions shall be governed by and interpreted in accordance with the laws of the State of Mississippi.

10. Any instrument hereafter conveying any interest in the Property or any portion thereof shall contain a recital acknowledging this Declaration and providing the recording location of this Declaration.

IN WITNESS WHEREOF, City of Grenada has executed this

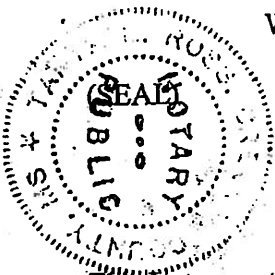
Declaration of Use Restrictions as of the day and year first written above.

CITY OF GRENADA, MISSISSIPPI
 By: Dianna Freelon Foster
 Its: MAYOR
 Date: December 14, 2004

STATE OF MISSISSIPPI)
) ss:
 COUNTY OF GRENADA)

Before me, a Notary Public, in and for said County, personally appeared Dianna Freelon Foster as Mayor of City of Grenada who acknowledged the signing of the foregoing instrument to be his free act and deed and that of Grenada for the uses and purposes therein mentioned.

Witness my hand and Notarial Seal this 14th day of DECEMBER, 2004.



[Signature]

Notary Public

My Commission Expires

MISSISSIPPI STATEWIDE NOTARY PUBLIC
 MY COMMISSION EXPIRES FEB. 17, 2008
 BONDED THRU STELLA NOTARY SERVICE

This Instrument Was Prepared By:

Mary A. Brown
 Attorney-at-Law
 P.O. Box 2046
 Grenada, Mississippi 38902
 662-226-5878
 MS Bar #: 4661

Indexing Instructions

Part of the SE quarter
 of the NW quarter of
 Section 5, T22N,R5E,
 Grenada County,
 Mississippi and Part
 of the SW quarter of
 the NW quarter of
 Section 5, T22N,R5E,
 Grenada County,
 Mississippi

